THE VALUE OF WATER IN AGRICULTURE LAND MARKETS: *THE NEBRASKA CASE*

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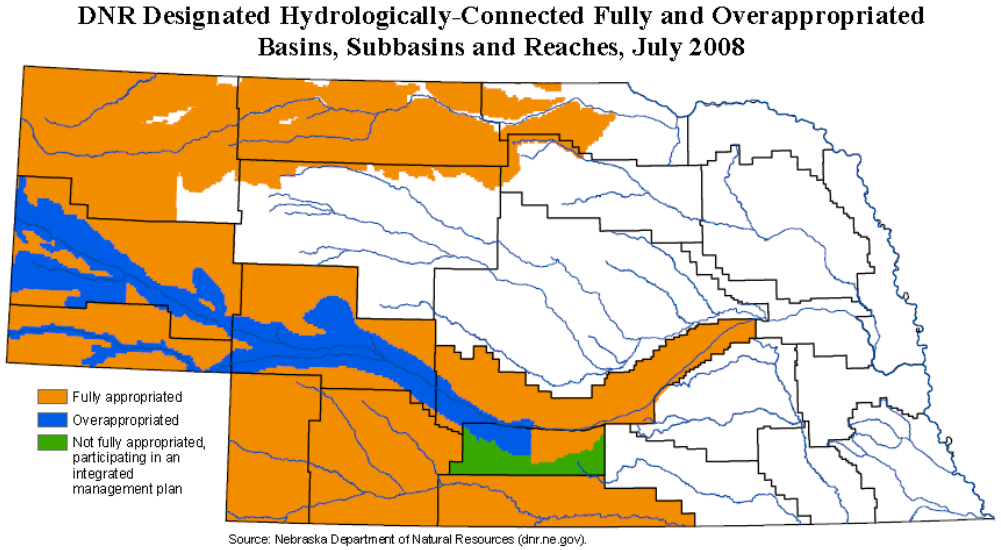
Nebraska Water Issues

- Approximately 8.6 million acres of irrigated cropland.
  - Approximately 6.7 Million acre ft. of water applied
    - About 80% = Sprinkler (1% Change each year)
      - 40 % of Sprinklers are Low Pressure

- Since Pre-development of Irrigation (1950s) we have pumped less than 1% Of Nebraska's Portion of the High Plains Aquifer (USGS)

The interaction of Groundwater Irrigation and Surface-water Flows are key for Nebraska Policies:

- Remember what one irrigator pumps another irrigator may use rely on.
- Increases in Efficiency



The *Value* of Water

Contribution to productive capacity

Nebraska Land Market illustrates the *PERCIEVED* contribution to productive capacity

PRICE* ≠ *VALUE → ***Depends on the type of market participant***

Irrigation Terminology:

WATER RIGHTS – right to irrigate into the future

ANNUAL WATER RIGHT – Right to irrigate in a single year

ECONOMIC VALUE – the "worth" of the resource, represents a prospective income flow into the future.

PRICE – dollars paid to acquire the water rights

COST – sometimes referred to the cost to acquire the physical water.

APPLIED WATER – water pumped and ran through an irrigation system.

CONSUMED WATER – a portion of the applied water that is readily available to the crop for yield production.

Determining Value

2 main methods applicable in Nebraska

Land Value Method:

an inductive valuation technique, is a simple method based on comparing land market transactions of irrigated and non-irrigated land

Market Value Method

Based on:

The market price of Irrigated Land

The market price of Non-Irrigated Land

Cash Rental Market Method

Based on:

The cash rent price of Irrigated Land

The cash rent price of Non-Irrigated Land

Value of Irrigated – Value of Dryland = Perception of value in Market

Annual Residual Rent Method

a deductive method using a representative farm model

Based on:

- crop growth production characteristics
- Assumed Cropping Pattern
- An assumed future income stream and rate of return

Basic Profit Function :

$TR_{irr} – Tc_{irr} – TR_{dry} – TC_{dry}$ = Productive value of Water

Nebraska Farm Real Estate Market Panel Survey

- ***Part 1a:***
  - Reported $/acre the current LAND prices.

Water Rights Value

- ***Part 1c:***
  - Reported in $/acre the current LAND prices by quality of Land.

Water Rights Value

- ***Part 2a:***
  - Reported in $/acre the current RENTAL CONTRACT prices and capitalization rate

Annual Water Rights Value

- ***Part 3:***
  - Irrigation Characteristics

How participants perceive irrigation restrictions

Survey Highlights can be found at

http://agecon.unl.edu/realestate.html

Survey Results – Land Value Method by System Type

Reporting District	Value of Water per Acre on Gravity Irrigated Cropland	Value of Water per Acre on Pivot Irrigated Cropland
South	$1,232.95	$1,539.77
Southwest	$1,053.75	$1,554.89
Central	$1,205.36	$1,407.86
Northwest	$958.33	$1,168.75
Value of Water = Irrigated Cropland Values minus Dryland Cropland Values		
Source: 2010 Nebraska Farm Real Estate Survey		

Value of Water Under Pivot Development (% of Irrigated Value)

Central – $3470 = **40%**

South – $3575 = **43%**

Southwest – $2475 = **62%**

Northwest – $1650 = **70%**

Survey Results – Land Value Method by Quality

	Survey Calculated Value of Water per Acre			
Reporting District	Value of Water on Low Quality Gravity Irrigated Cropland	Value of Water on High Quality Gravity Irrigated Cropland	Value of Water on Low Quality Pivot Irrigated Cropland	Value of Water on High Quality Pivot Irrigated Cropland
South	$837.12	$1,413.26	$1,016.67	$1,833.71
Southwest	$877.98	$1,408.93	$1,060.83	$1,877.50
Central	$636.11	$1,825.00	$678.67	$2,287.50
Northwest	$559.52	$1,183.33	$841.67	$1,633.33
Average	$735.69	$1,470.69	$902.21	$1,921.09
Value of Water = Irrigated Cropland Values minus Dryland Cropland Values				

Source: 2010 Nebraska Farm Real Estate Survey

Higher Quality Land includes an greater willingness to pay for irrigation rights

Average Added WTP = **$1020 for pivot developed land**

Average Added WTP = **$735 for gravity developed land**

Survey Results – Cash Rental Method

	Survey Calculated Value of Water per Acre					
Reporting District	Average Rental Value of Water* - Gravity Irrigated Cropland	Average Rental Value of Water* - Pivot Irrigated Cropland	Average Market Value of Water** - Gravity Irrigated Cropland	Average Market Value of Water** - Pivot Irrigated Cropland	Capitalization Rate of Water*** - Gravity Irrigted Land	Capitalization Rate of Water*** - Pivot Irrigted Land
South	$106.55	$130.00	$1,783.50	$2,201.00	**5.97%**	**5.91%**
Southwest	$93.70	$124.70	$1,458.33	$1,622.22	**6.43%**	**7.69%**
Central	$100.00	$115.09	$1,511.56	$1,681.00	**6.62%**	**6.85%**
Northwest	$85.17	$113.50	$1,022.02	$1,366.67	**8.33%**	**8.30%**

*Rental Value of Water = Irrigated Rental Rate minus Dryland Rental Rate

**Market Value of Water = Irrigated Cropland Market Value minus Dryland Cropland Market Value

***Capitolization Rate of Water = Rental Rate of Water divided by Market Value of Water

Source: 2010 Nebraska Farm Real Estate Survey

ANNUAL Value of Water Per Acre + **Value of Water Right Per Acre** = **Cap Rate**

<u>Capitalization rate</u> is the annual accrual of an investments worth. It basically measures how fast an investment total worth will be realized. - ***Riskiness in the Market***

<u>Higher Capitalization Rate = Swifter returns</u>

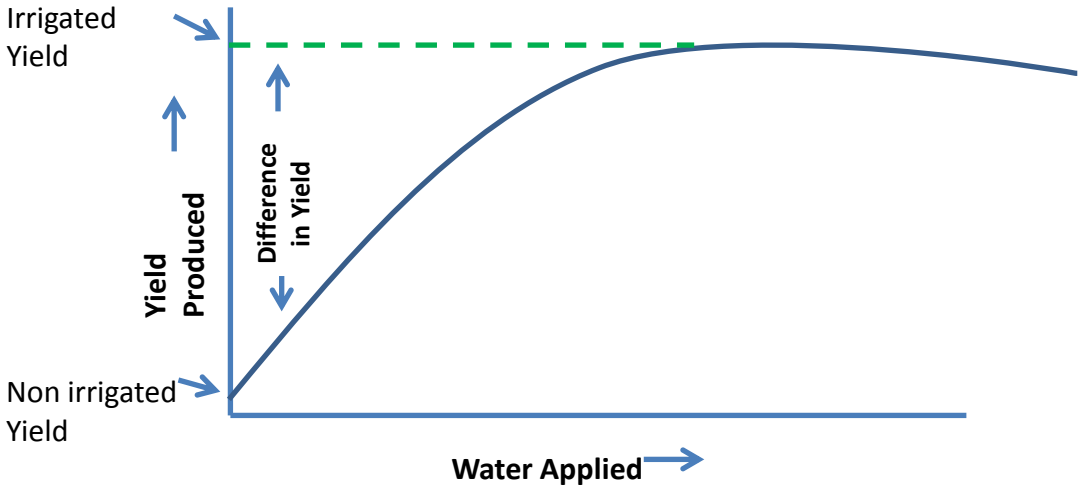
Happens in areas where future water supplies may not represent a steady investment.

Survey Results - Irrigation Characteristics

Permanent 25% Change in Water Availability				
Reporting District	**South**	**Southwest**	**Central**	**Northwest**
	Reported Range of the Resulting Reduction in Market Value			
Gravity Irrigated Land	16% - 28%	10% - 22%	13% - 20%	12% - 24%
Pivot Irrigated Land	15% - 26%	9% - 20%	11% - 19%	7% - 20%
Permanent 50% Change in Water Availability				
Reporting District	**South**	**Southwest**	**Central**	**Northwest**
	Reported Range of the Resulting Reduction in Market Value			
Gravity Irrigated Land	30% - 39%	23% - 41%	22% - 31%	19% - 36%
Pivot Irrigated Land	25% - 28%	21% - 39%	20% - 29%	14% - 30%

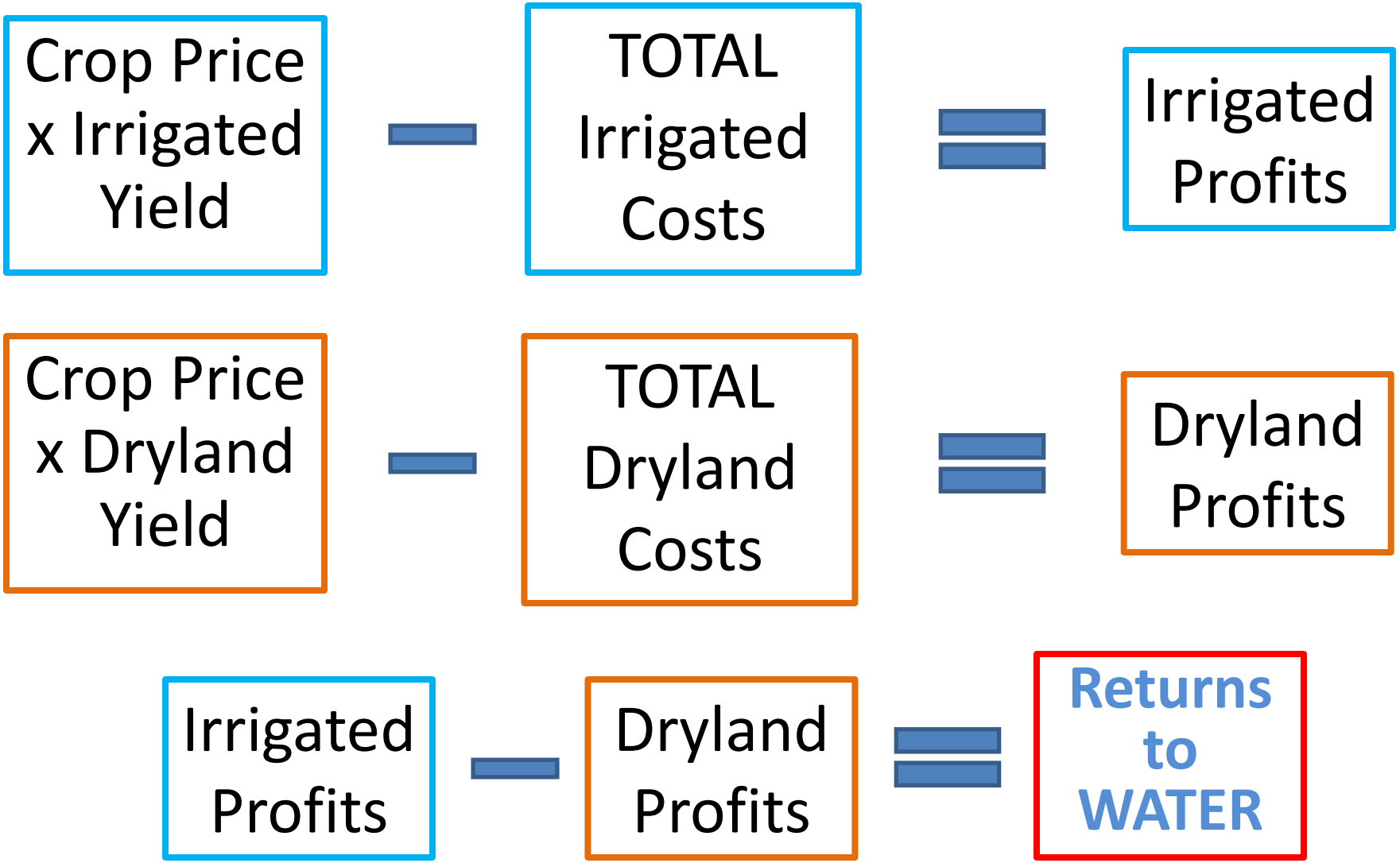
Source: 2010 Nebraska Farm Real Estate Survey

The results seem to reflect the Cobb-Douglass production function well!



Source Martin et al. 1989

Residual Rent Method



Comparison of Values

	Market Survey	Water Optimizer
Reporting District	Average Annual Value of Water*	Average Annual Value of Water**
South	**$118**	**$231**
Central	**$109**	**$266**
Southwest	**$108**	**$220**
Northwest	**$99**	**$252**

* As derived from the Nebraska's 2010 Cropland Rental Market
** As Derived using 2010 average prices and input costs within Water Optimizer

Source: Water Optimizer, 2010 and 2010 Nebraska Farm Real Estate Survey

Water Optimizer was used as a representative farm model to allocate water to the most profitable crops in each area. **www.wateroptimizer.unl.edu**

In 2010 the Productive capacity of water per acre was greater than the price to acquire the water that year.

- The added value goes to the irrigator

Over time residual returns is very volatile.

- The value of water does not really change just the parameter that we use to measure value.

Conclusions

- The ***Value of Water Rights*** range from $1000 - $1600 depending on location in 2010.
- ***Annual Value*** is around $110 give or take $20 to account for location and quality of land.
- A quick estimate of water right value is a percentage of irrigated land value for that location.
- Uncertainty of future conditions play a part in water rights valuation.

This has been a 2010 snapshot of Water Valuation in Nebraska

Further Results

- Extend the methodology to 30 years of results
- Understand what drives the annual market and the water rights market.
- Understand real annual returns to an investment in water rights
- Understand how real rates of return have changed over time.

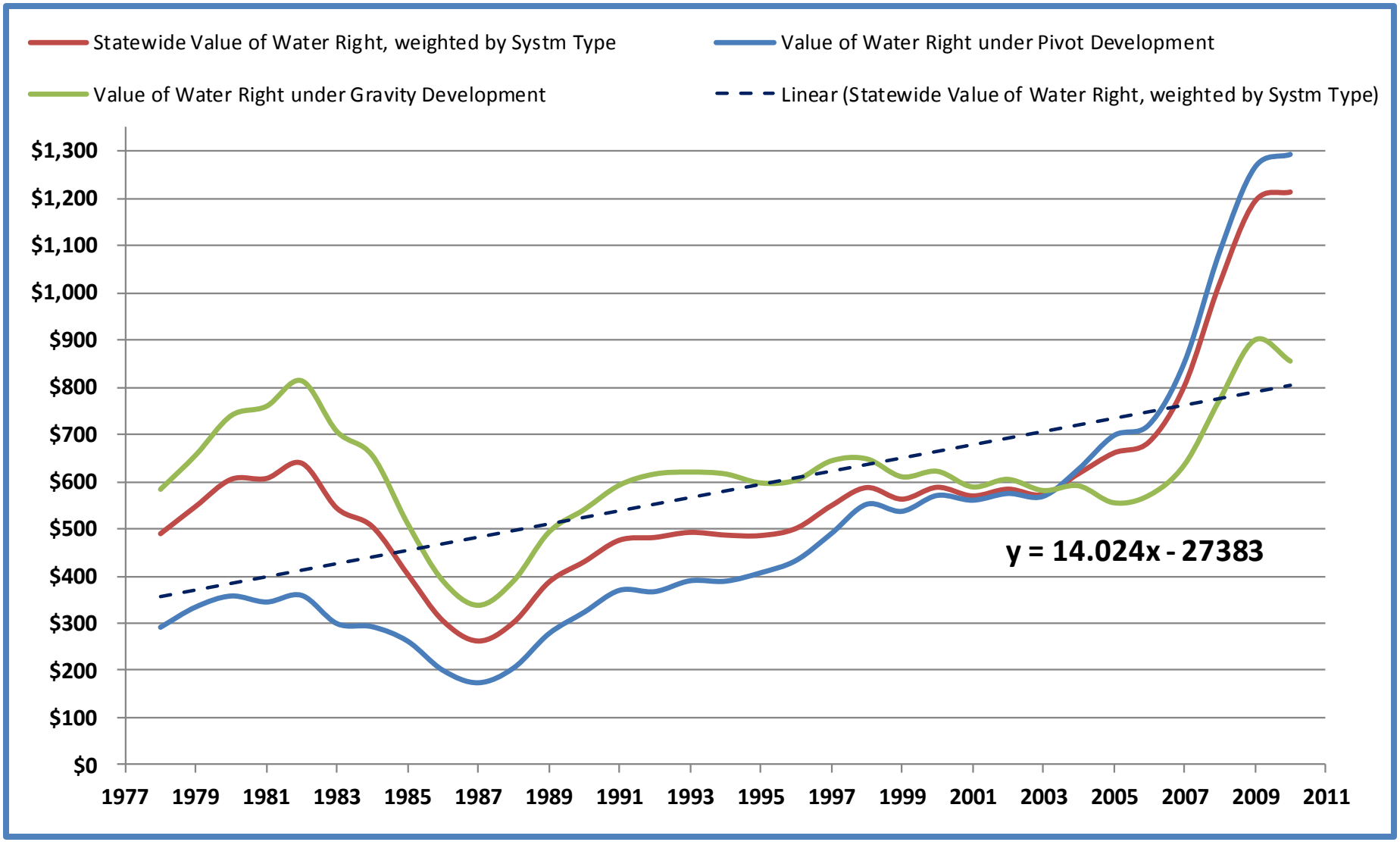
EASY

Compiling the land market's perception of value for 30 years.

HARD

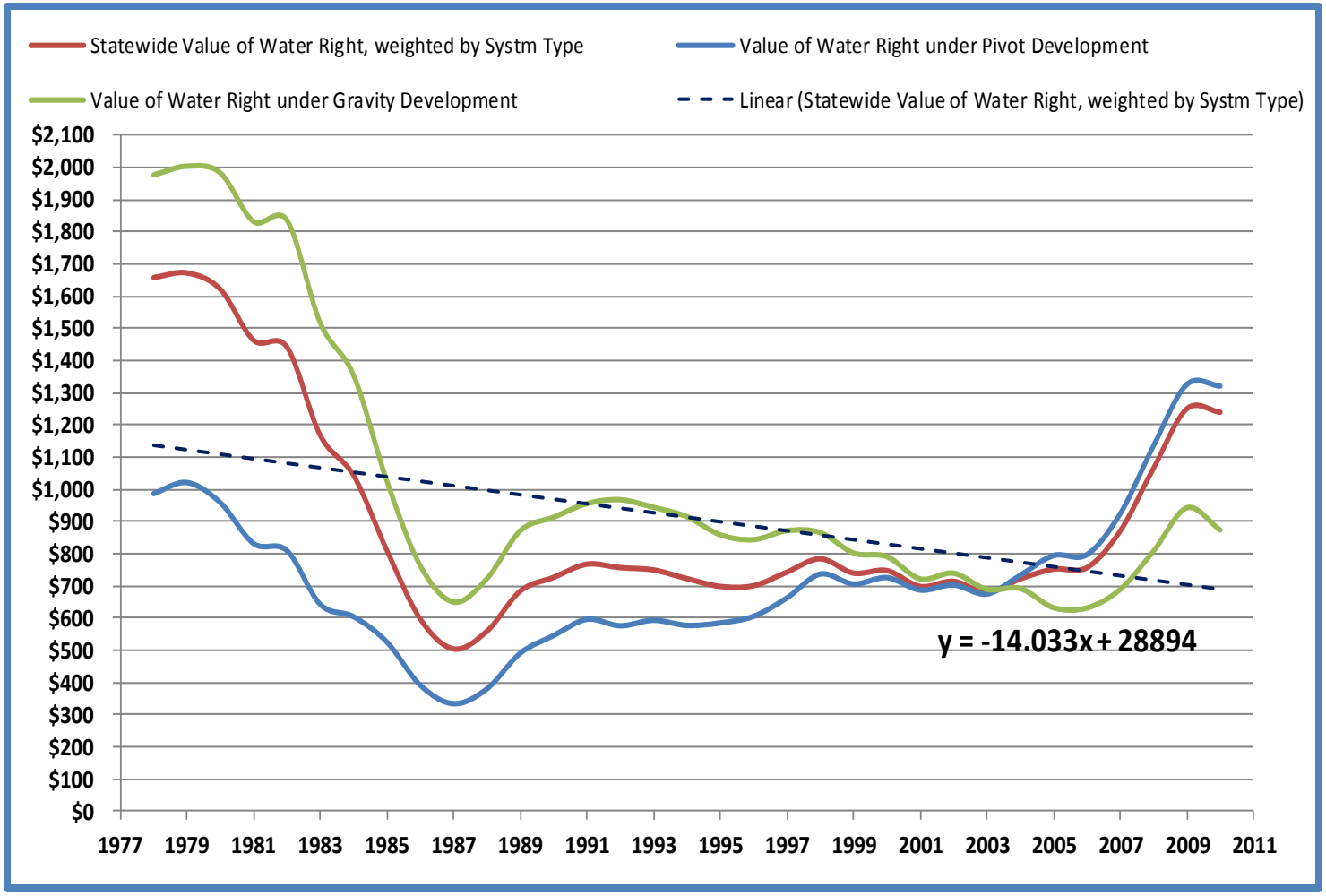
Calculating Residual Returns for 30 years and aggregating the results

Value of Water Rights over Time



Conversion from Gravity to Pivot at about 1% per year statewide.

Value of Water Rights over Time Adjusted to 2011 dollars



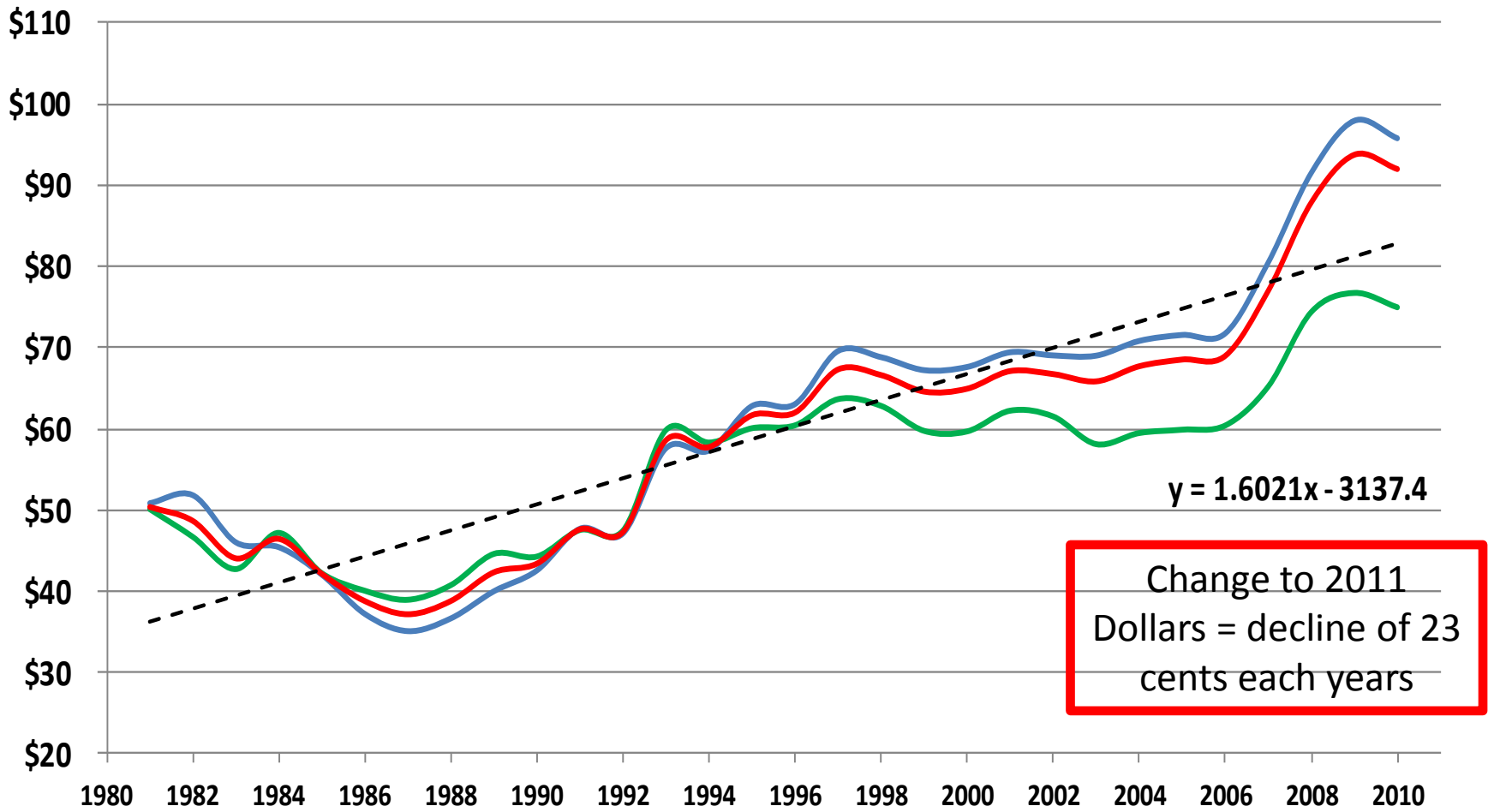
Inflation Rate and crop price play a big role.

Average Corn Price 1981 $2.92

2011 Dollars $6.89

With yields increasing and essentially the same crop price as the early 80's the relative value of water is falling, thus become more competitive with other competing uses.

Value of Annual Water Rights over Time



Less variance than Water Rights Markets suggesting they respond to different stimuli.

What Variables Drive the Price of Water Rights in the Nebraska Land Market?

Variance of Water Rights values indicates ***Short Term*** stimuli *determine prices paid in the Land Market.*

Key Variables

- Recent Revenue
  - Crop Price (recent prices)
  - Irrigated Yield
- Ability to borrow $

→

Resulting Statistics

- $1 increase in revenue = $1.40 increase in Water rights price
- 1% increase in borrowing rate = $-73.43 change in Water Right Value

Economist like their models responding to the proper indicators!

What Variables Drive the Price of Water in the Nebraska Cash Rental Market?

There is Less Variance in the price of water in the Cash Rental Markets suggesting annual prices paid for water are based on longer term stimuli.

Key Variables
- Recent contract prices
- Corn Price
- Irrigated Yield

Again!

Resulting Statistics
- $1 increase in recent contract prices = $0.94 increase in annual water rights price
- $1 increase in corn price = $3.03 increase in annual water rights price
- 1 bushel increase in Irrigated Crop Yield = $0.12 increase in water rights price

Return to Water Over Time

Suppose someone invests in Irrigated Land

- Does the amount they pay for irrigation rights adequately reflect the return over time in the cash rental market?
- Have 30 years worth of data

1981 Water Rights Purchase = @ $358

1981 Cash Rental Rate of Water = @ $51

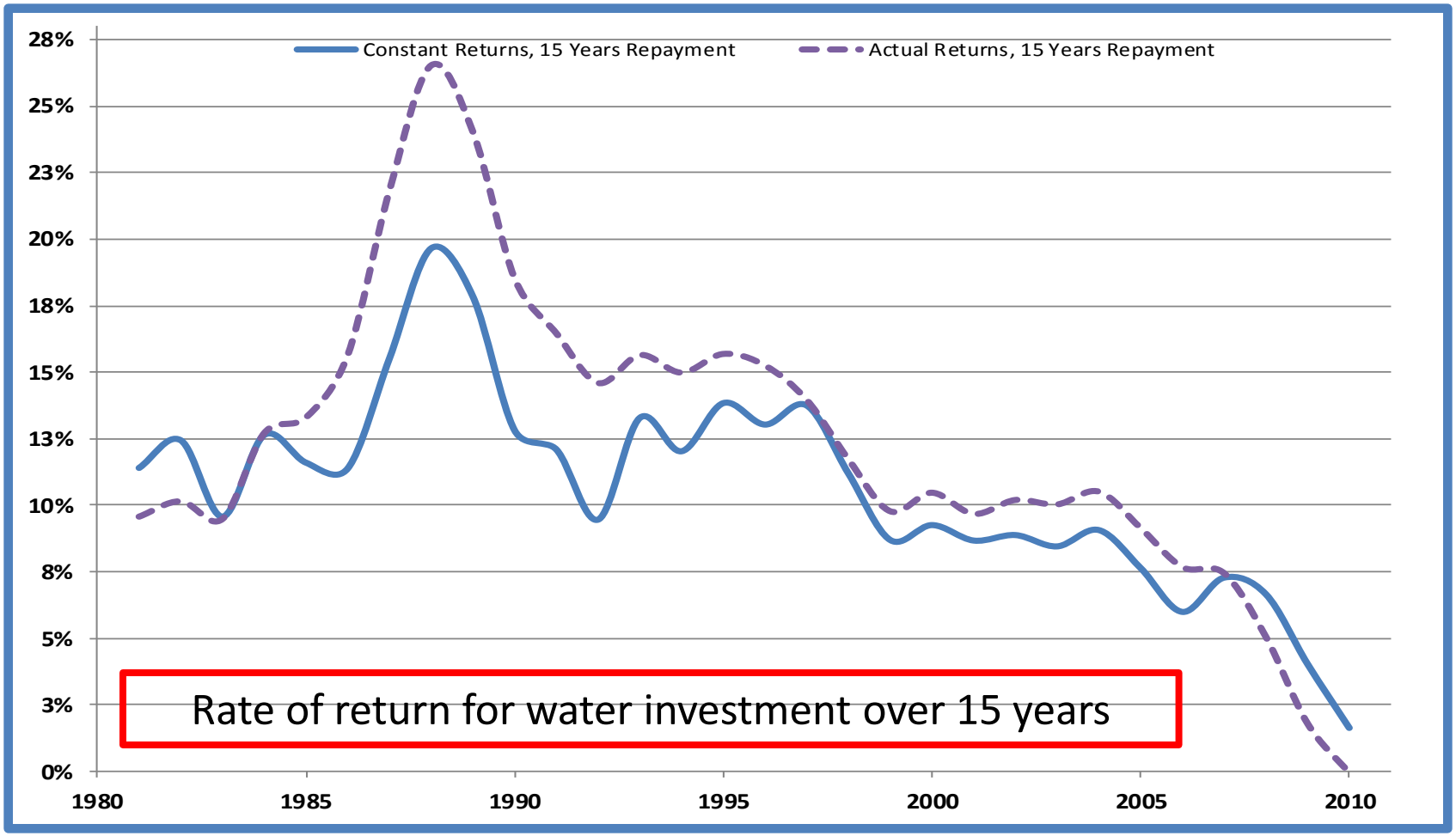
Constant Returns → NPV of $51 over 15 years = $528

Actual Returns → NPV of returns form Cash rental market for the next 15 years = $478

10 years = 392 for constant and 334 for actual

Return to Water Over Time

If we hold the time period constant we can get the actual returns to investment.



Very high returns quickly in the 80's – present time paying more for the water than they can re-coup in 15 years

Productive Capacity compared to Annual Cash Rental Market Prices

Southwest District - Pivot Irrigated

	Irrigated				Dryland				
Year	**Crop Price**	**Irrigated Yield**	**Irrigated Revenue**	**Irrigated Cost**	**Dryland Yield**	**Dryland Revenue**	**Dryland Cost**	**Residual Return To Water**	**Annual Cash Rental Rate of Water**
1992	$2.31	139	$320	$166	74	$170	$82	$66	$74
1994	$2.41	160	$386	$169	75	$181	$89	$125	$79
1996	$3.55	148	$526	$179	85	$300	$95	$143	$82
Average	***$2.76***	***149***	***$411***	***$171***	***78***	***$217***	***$89***	***$111***	***$78***
2001	$ 1.89	180	$340	$255	71	$135	$149	$98	$84
2004	$ 2.47	186	$460	$252	69	$169	$154	$193	$84
2006	$ 2.28	192	$437	$331	48	$110	$191	$187	$89
Average	***$2.21***	***$186***	***$412***	***$279***	***$63***	***$138***	***$164***	***$159***	***$84***

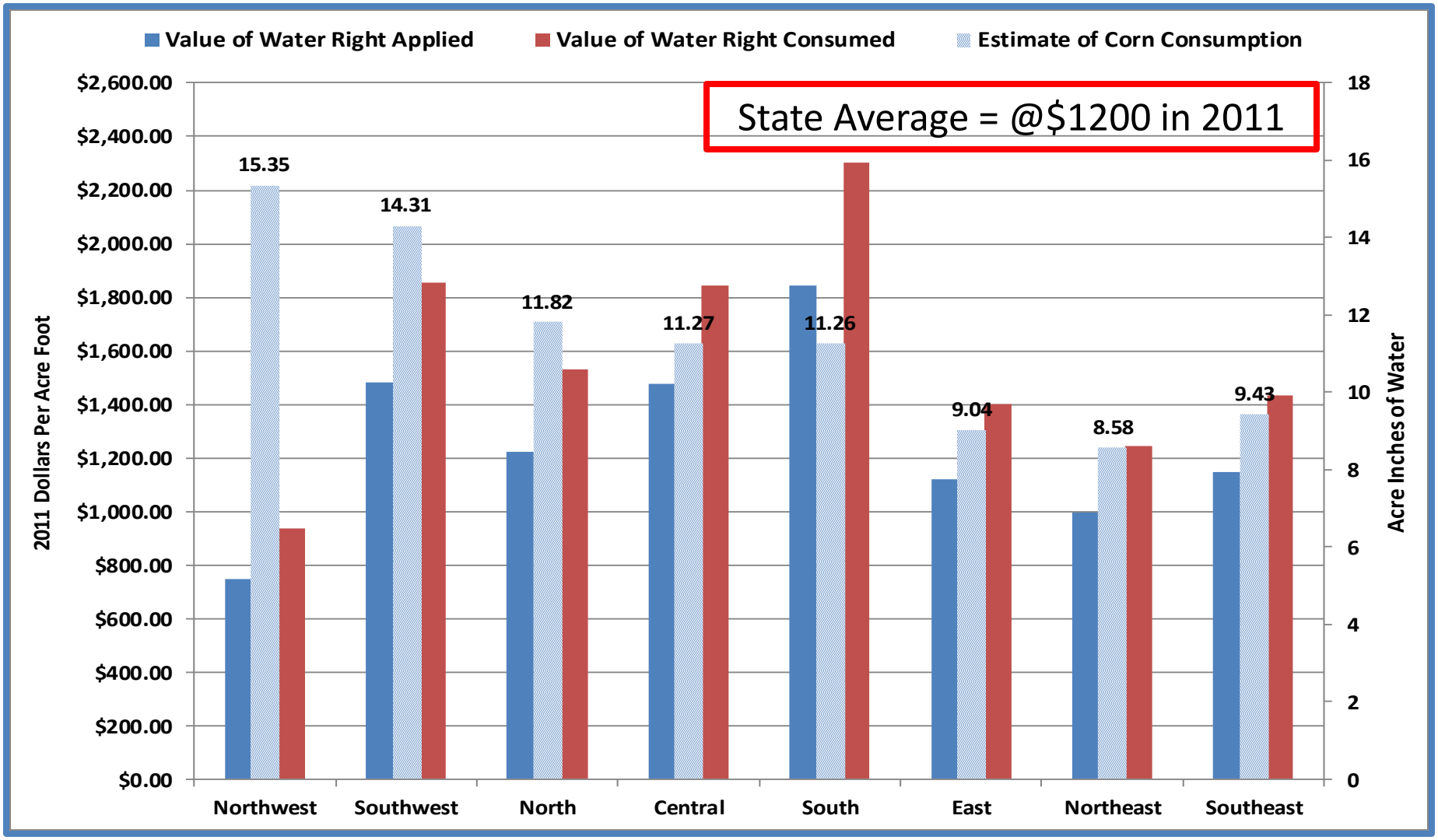
Discrepancies between the RR calculations and the Annual Water Right Value

- Lagging Cash Rental market?
- Asymmetric information? Renters knows better?

Or

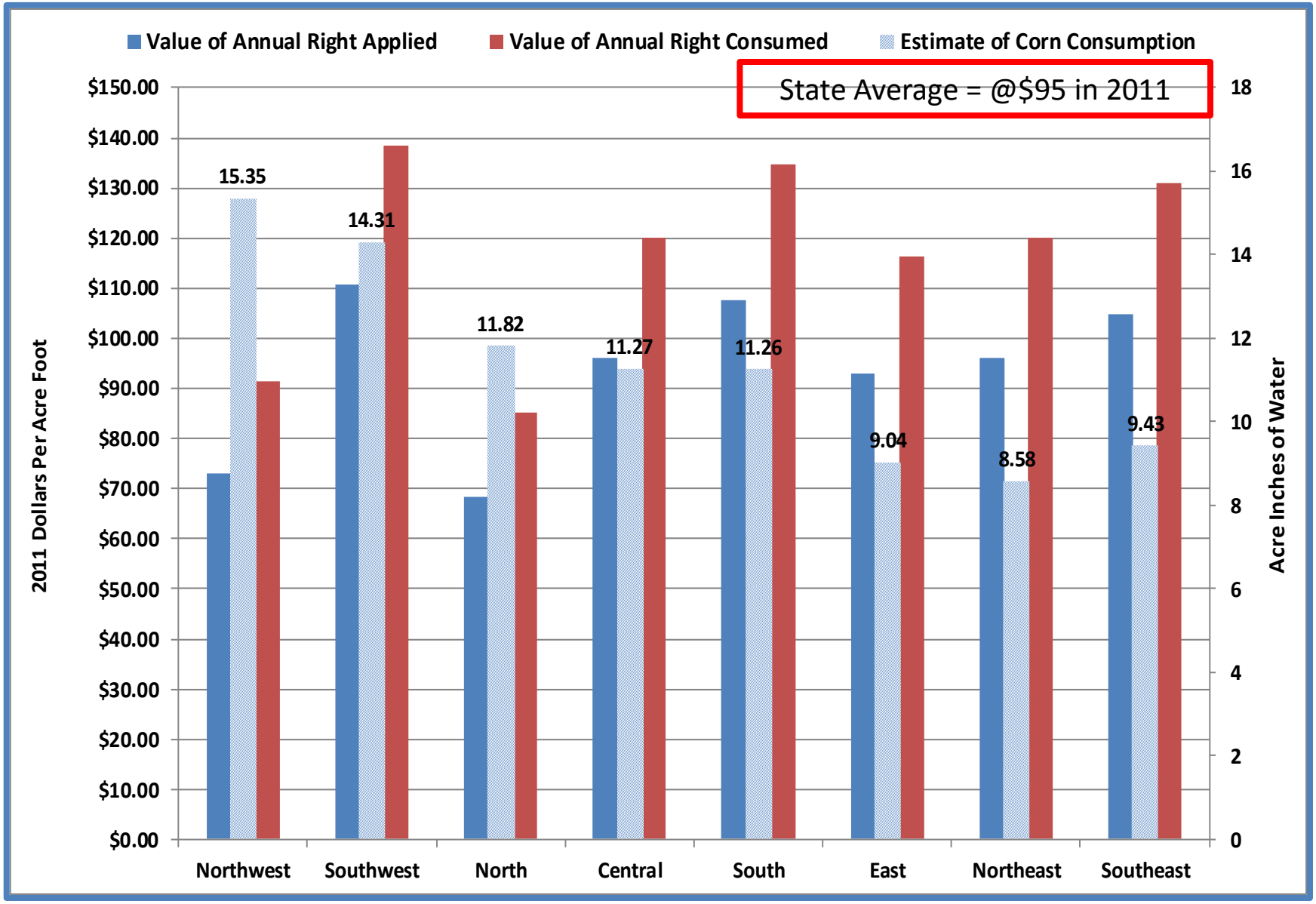
- Our residual return calculations are not capitalizing the real value of Irrigators management and time. (example: premium for pivot water rights)

Value of Water Per Acre Ft



In the west you have to apply more water to get the same crop, Thus a lower per unit value of water.

Annual Value of Water Per Acre Ft



Additional Conclusions

- The Nominal Value of Water Rights and the right to annual usage have increased in nominal value over time. However, the Real Values have decreased, and if the trend continues, future water use will be worth less than it is today.

- Market Trends
  - Water Rights = short term reactions to revenue and the ability to borrow capital.
  - Annual Water Rights = steadier trends in economic indicators such as sustained growth in the water rights market as well as sustained crop prices and yields.

- Value of water per unit goes down as we go west.

- Irrigated agriculture production has historically resulted in returns to water that are shared by both the irrigator and the land owner.

- In the early years of the time series the water market was underestimating the true value of the water. Presently the market is doing a much better job of understanding returns to water.


Questions?