ECONOMICS OF NATIVE SEED PRODUCTION FOR RECLAMATION OF DISTURBED LANDS IN WYOMING

Betsy Mock
Kristiana Hansen
Roger Coupal
INTRODUCTION

- Motivation/Background
- Interviews
- Enterprise budgets
- Laboratory Experiment
- Conclusion and Recommendations
WHY IS THE NATIVE SEED INDUSTRY IMPORTANT?

- Native seed supply is a vital component in the reclamation process in the West.
- Types of Reclamation in Wyoming
  - Over 70,000 working oil and gas wells
  - 21 coal mines
  - 231 highway improvement projects
  - 73,865 acres burned (7-year) average
- Federal Lands make up 48% of Wyoming’s total acreage

Reclamation Practitioners want more grass, forb, and shrub seed, but seed producers/collectors are not delivering either the right species or quantities, at the required time.

Some species are in excess supply and some species are in excess demand.
The biological theory is that native plants may be the best at restoring particular ecosystem functions with the least amount of unintended side effects.

Native plants are not like commodity crops
- Survival and dormancy mechanisms
- Potential symbiotic requirements

Wyoming is unique among the 11 Western States
- BLM policy in Wyoming obligates the use of native plant material with few exceptions
- Wyoming does not have major fire cycles like many other Western states
  - At least partially attributed to lower amounts of cheatgrass and other early-maturing invasive grasses
BACKGROUND: LIFECYCLE OF NATIVE SEED

1. Native Seed Collection
2. Evaluation & Development
3. Field Establishment
4. Seed Production by Private Growers
5. Seed Storage
6. Restore Native Plant Communities
OBJECTIVES

- What needs to be done now?
  - Forming a general picture of the native seed market landscape
  - Understanding Production and Demand Requirements
    - Biology/Ecology
    - Cultural Practices
- What can be done to facilitate this market?
  - How do different market structures affect the profits of native seed producers?
  - What market structure is the best for the native seed market?
INTERVIEWS: MARKET PLAYERS

- **Supply**
  - Producers
  - Intermediaries
  - Federal research centers

- **Demand**
  - Buyers aka Responsible Party
  - Subcontractors
  - Regulators
    - Regulators are also buyers (BLM, etc.)

The native seed market is relatively young and much more volatile than other common Wyoming commodities.

- There are extreme fluctuations in the native seed industry’s prices and quantities demanded.
- Peaks and troughs vary in both breadth and depth.

A comparison of Common Commodity Prices to Thickspike Wheatgrass 'critana'
<table>
<thead>
<tr>
<th>Type of Uncertainty</th>
<th>Supply uncertainty is caused by:</th>
<th>Demand uncertainty is caused by:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market</td>
<td>Species and quantity demanded can be impulsive and unpredictable, 2-yr commitment</td>
<td>Species and quantity availability can be sporadic</td>
</tr>
<tr>
<td>Financial</td>
<td>Producer liquidity and operating capital; Loan flexibility</td>
<td>Emergency Funds vs. Yearly budget funds</td>
</tr>
<tr>
<td>Meteorological</td>
<td>Precipitation and climatic variability</td>
<td>Precipitation and climatic variability, Fire, Multiple reclamation attempts at same site.</td>
</tr>
<tr>
<td>Biological/Ecological</td>
<td>Plant survival methods, Genotypes, and Ecosystem interactions are not fully understood.</td>
<td>Plant survival methods, Genotypes, and Ecosystem interactions are not fully understood.</td>
</tr>
<tr>
<td>Philosophical/Situational</td>
<td>Local vs. broad genotype usage</td>
<td>Local vs. broad genotype usage</td>
</tr>
<tr>
<td>Regulatory</td>
<td>Regulations governing native seed change rapidly and without adequate warning time.</td>
<td>Regulations governing native seed change rapidly and without adequate warning time. The degree to which substitution of species is allowed.</td>
</tr>
</tbody>
</table>
Prices of four native wheatgrasses from 1990 to 2002

- Secar' Snake River wheatgrass
- Critana' thickspike wheatgrass
- Pryor' slender wheatgrass
- Rosana' western wheatgrass
INTERVIEWS: EXAMPLE OF QUANTITY VOLATILITY

BLM Consolidated Seed Buy Quantities

- **Non-Native Seed**
- **Native Seed**

Year

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>701,650</td>
<td>327,670</td>
<td>238,450</td>
<td>239,400</td>
<td>1,484,295</td>
<td>1,484,295</td>
<td>1,083,255</td>
<td>972,235</td>
<td>493,498</td>
<td>1,349,750</td>
</tr>
<tr>
<td>378,750</td>
<td>135,330</td>
<td>169,390</td>
<td>1,803,750</td>
<td>2,089,245</td>
<td>2,521,395</td>
<td>1,318,400</td>
<td>1,318,400</td>
<td>534,622</td>
<td>667,731</td>
</tr>
<tr>
<td>2,486,650</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2,166,025</td>
</tr>
</tbody>
</table>
INTERVIEWS: SUMMARY

- Production knowledge is crucial for producers, regulators, and reclamation agents.
- More research into the biology and ecology of species is needed.
- Both Supply and demand players acknowledge dysfunction.
- The BLM is the big buyer, making up 70%-80% of all demand if we include individual district office buys and seed bought through the BLM by private industry.
- The way in which federal funds are allotted to the BLM accounts for much of the variability in demand.
- Market uncertainty comes from multiple sources, which makes meeting demand a gamble for producers. So diversity in production and producer liquidity are essential for producer survival.
Enterprise budgets

- An overview of production economics
  - Forbs and Shrub Issues
  - Thickspike Wheatgrass ‘critana’
  - Indian Ricegrass

- Capital costs are not included as capital structures can vary widely among different farms.

http://www.wy.blm.gov/jio-papo/papo/reclamation.htm
# Partial Enterprise Budgets: Thick Spike Wheatgrass Summarized

<table>
<thead>
<tr>
<th></th>
<th>$/Per Acre</th>
<th>$/Per Field (30 acres)</th>
<th>Average Yield Lbs/Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Prep and planting</td>
<td>$514.00</td>
<td>$15,420.00</td>
<td>Year 0</td>
</tr>
<tr>
<td>Yearly Crop Maintenance</td>
<td>$918.00</td>
<td>$27,540.00</td>
<td>Year 1</td>
</tr>
<tr>
<td>Harvest*</td>
<td>$438.00</td>
<td>$13,140.00</td>
<td>Year 2</td>
</tr>
<tr>
<td>Field &amp; Seed Fees</td>
<td>$486.50</td>
<td>$486.50</td>
<td>Year 3</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td><strong>$2,356.50</strong></td>
<td><strong>$56,586.50</strong></td>
<td>Year 4+</td>
</tr>
</tbody>
</table>

## Market Price

<table>
<thead>
<tr>
<th>Year</th>
<th>Break Even Price</th>
<th>Income Per Acre</th>
<th>Total Income (30 acres)</th>
<th>Net Income (30 acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>$1.57</td>
<td>$1,887.90</td>
<td>$56,637.00</td>
<td>$50.50</td>
</tr>
<tr>
<td>1992</td>
<td>$2.50</td>
<td>$4,393.50</td>
<td>$131,805.00</td>
<td>$75,218.50</td>
</tr>
</tbody>
</table>

## Current Price

<table>
<thead>
<tr>
<th>Year</th>
<th>Market Price</th>
<th>Income Per Acre</th>
<th>Total Income (30 acres)</th>
<th>Net Income (30 acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>$2.51</td>
<td>$4,420.50</td>
<td>$132,615.00</td>
<td>$76,028.50</td>
</tr>
<tr>
<td>1992</td>
<td>$1.42</td>
<td>$1,477.50</td>
<td>$44,325.00</td>
<td>($12,261.50)</td>
</tr>
<tr>
<td>1994</td>
<td>$3.73</td>
<td>$7,714.50</td>
<td>$231,435.00</td>
<td>$174,848.50</td>
</tr>
<tr>
<td>1996</td>
<td>$3.27</td>
<td>$6,472.50</td>
<td>$194,175.00</td>
<td>$137,588.50</td>
</tr>
<tr>
<td>1998</td>
<td>$5.95</td>
<td>$13,708.50</td>
<td>$411,255.00</td>
<td>$354,668.50</td>
</tr>
<tr>
<td><strong>2000</strong></td>
<td>$6.29</td>
<td>$14,626.50</td>
<td>$438,795.00</td>
<td><strong>$382,208.50</strong></td>
</tr>
<tr>
<td>2002</td>
<td>$1.75</td>
<td>$2,368.50</td>
<td>$71,055.00</td>
<td>$14,468.50</td>
</tr>
</tbody>
</table>

*Does not include storage costs
<table>
<thead>
<tr>
<th></th>
<th>$/Per Acre</th>
<th>$/Per Field (30 acres)</th>
<th>Year 0</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Field Prep and planting</strong></td>
<td>$ 521.00</td>
<td>$ 15,630.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Yearly Crop Maintenance</strong></td>
<td>$ 933.00</td>
<td>$ 27,990.00</td>
<td></td>
<td>800.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Harvest</strong></td>
<td>$ 368.00</td>
<td>$ 11,040.00</td>
<td></td>
<td></td>
<td>600.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Field &amp; Seed Fees</strong></td>
<td>$ 555.50</td>
<td>$ 555.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$ 2,377.50</td>
<td>$ 55,215.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

|                      |            |                       |        |        |        |        |        |        |
| **Market Price** |            |                       |        |        |        |        |        |        |
| **Income Per Acre** |            |                       |        |        |        |        |        |        |
| **Total Income (30 acres)** |            |                       |        |        |        |        |        |        |
| **Net Income (30 acres)** |            |                       |        |        |        |        |        |        |

| **Break Even Price** | $ 1.81 | $ 1,846.50 | $ 55,395.00 | $ 179.50 |
| $ 2.00 | $ 2,416.50 | $ 72,495.00 | $ 17,279.50 |
| $ 3.00 | $ 5,416.50 | $ 162,495.00 | $ 107,279.50 |
| **Current Price** | $ 3.50 | $ 6,916.50 | $ 207,495.00 | $ 152,279.50 |
| $ 4.00 | $ 8,416.50 | $ 252,495.00 | $ 197,279.50 |
| $ 5.00 | $ 11,416.50 | $ 342,495.00 | $ 287,279.50 |

*Does not include storage costs
Input costs and time commitment are significant.

Opportunity costs are even more significant, especially since most native grasses grown in Wyoming take a minimum of 2 growing seasons.

Prices can fluctuate greatly between successive seasons, so the highs need to be able to make up for the lows.

Significant biological differences between species equals significant production and returns differences.
We conducted market experiments to simulate the native seed market using economic principles.

- Lack of real world data
- Controls for outside influences on market behavior
  - Test the direct relationship between market behavior and differences in market structures.
- Lab experiments are reasonably predictive
- Better understand the relationship between supply and demand under a big buyer scenario
- Rounds out the rest of the research on the native seed industry
LAB EXPERIMENT: BIG BUYER TREATMENTS

Big Buyer (3 buyers, 4 sellers)

Spot Market (higher risk)

Variable Demand
Constant Demand

Forward Contracting (lower risk)

Variable Demand
Constant Demand
Lab Experiment: Results

Total Earnings (Surplus)

- Current Market
- Competitive Market

Period

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
LAB EXPERIMENT: RESULTS

Total Earnings (Surplus)

Period
Total
Earnings
(Surplus)

Current Market
Leveled Demand
Competitive Market

600 700 800 900
1000 1100 1200 1300
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
LAB EXPERIMENT: RESULTS

Total Earnings (Surplus)

Period

Current Market
Leveled Demand
Forward Contract
Competitive Market
Current general market structure is spot-market with variable demand and a big buyer.

- The current market structure earns the least amount of total profit.
- Leveling demand increases total market earnings
- Forward contracting increases total market earnings more than leveling demand
- Forward contracting and leveling demand together show the greatest increase in total market earnings
- Total market earnings do not show the relationship between sellers and buyers
Relative Earnings
(Buyer Surplus minus Seller Surplus)

Period

Tokens

Current Market
Competitive Market
Relative Earnings
(Buyer Surplus minus Seller Surplus)
LAB EXPERIMENT: RESULTS

Relative Earnings
(Buyer Surplus minus Seller Surplus)
LAB EXPERIMENT: RESULTS

Relative Earnings
(Buyer Surplus minus Seller Surplus)
LAB EXPERIMENT: RESULTS

Relative Earnings
(Buyer Surplus minus Seller Surplus)

- Current Market
- Competitive Market

Period

Tokens

Tokens
Relative earnings shows the gap between buyer and seller earnings

The current market structure shows a large gap between buyer and seller earnings, with seller earnings being much less than buyer earnings.

Leveling demand and contracting together would help decrease the buyer/seller gap.

High price is maintained when both forward contracting and leveling demand are implemented

All moves towards a more competitive market will increase the number of units sold

Implementing either leveled demand or forward contracting will benefit buyers more than sellers

LAB EXPERIMENT: RESULTS

- Any movement towards a more competitive structure would increase both buyer and producer earnings.
  - If only one structural change could be implemented, forward contracting would increase earnings the most for both producers and buyers.
  - Enlarges the pie

- Implementing forward contracting and leveling out demand would increase the proportion of total market profits going to producers.
  - By maintaining high price and increasing units traded
    - Enlarges the producers’ slice of that larger pie

http://www.endangeredspecieslawandpolicy.com/2010/03/
CONCLUSION AND RECOMMENDATIONS

- Leveled demand and forward contracting may allow for easier market entry
  - This would create a larger market
    - A larger market might reduce the Western US’ reliance on non-native seed.
  - Buyers would see increased profits by leveling demand for different species and quantities. However, these benefits would be most likely short-term without forward contracting.
    - Maintaining the producers’ desire to stay in the market may help secure steady supplies.
      - Potential gains must be worth the market risk
Mismatch between Supply and Demand may be smoothed out by:

1. Federal Emergency funds should be replaced with a more flexible and consistent federal funding system.

2. Federal regulations governing replanting timeframes should be more flexible.
   - This may also include time for planting interim species.

http://www.fws.gov/rockymountainarsenal/habitat/native/wildflowers/scarglobe.htm
Mismatch between Supply and Demand may be smoothed out by:

3. There should be more efficient information sharing among producers, buyers, and regulators.
   - This may include a higher reliance on intermediate agencies such as extension services to translate research, regulations, and realities to stakeholders.
   - This may include forward contracting with an elastic supply clause (the risk is transferred to/shared with the buyer).
   - There should be adequate forewarning to producers of upcoming demand changes (species, variety, quantity)

4. There should be better access to or understanding of biological aspects in the regulatory administrations.
QUESTIONS AND COMMENTS?

http://www.santafebotanicalgarden.org/HERB%20PAGES/H%20IndianRiceGrass.html;
http://www.flickr.com/photos/plant_diversity/4049544945/