

**energy**  
DIVISION

## Ethanol Impact Assessment For the State of Idaho

Contract No. CON 00532

Prepared for:

Idaho Department of Water Resources  
Energy Division  
P.O. Box 83720  
Boise, ID 83720-0098

Revised January 2004

**BBI International**  
P.O. Box 159  
Cotopaxi, Colorado 81223  
(719) 942-4353



# Table of Contents

<b>I. EXECUTIVE SUMMARY .....</b>	<b>1</b>
<b>II. INTRODUCTION .....</b>	<b>7</b>
<b>III. FEEDSTOCK PRODUCTION AND PRICING .....</b>	<b>9</b>
Feedstock Production.....	9
Whey.....	9
Wheat.....	9
Corn .....	11
Barley .....	12
Sugarbeet .....	13
Potato .....	14
Total Crop Production .....	15
Feedstock Pricing.....	16
Whey.....	16
Wheat.....	17
Corn .....	17
Barley .....	18
Potato .....	18
Sugarbeets.....	18
<b>IV. ETHANOL PRODUCTION POTENTIAL .....</b>	<b>19</b>
Southeast Ethanol Production.....	23
South Central Ethanol Production .....	23
Southwest Ethanol Production.....	24
Panhandle Ethanol Production.....	24
<b>V. ETHANOL CAPITAL AND OPERATING COSTS.....</b>	<b>26</b>
<b>VI. ECONOMIC IMPACTS.....</b>	<b>29</b>
Methodology.....	29
Analysis Inputs .....	30
Economic Impacts .....	31
Corporate and Personal Income Tax Revenues .....	32
Value Added to Wheat, Barley and Corn .....	33
<b>VII. CONCLUSIONS .....</b>	<b>35</b>

## List of Tables

Table 1 – Potential ethanol feedstock production and pricing data .....	1
Table 2 – Hypothetical Idaho ethanol production plants .....	3
Table 3 – Capital and operating cost estimates for Idaho ethanol plants.....	3
Table 4 – Economic impacts of ethanol production in Idaho .....	4
Table 5 – Estimated tax impacts of ethanol production in Idaho .....	5
Table 6 – Value added to Idaho grains by ethanol production .....	6
Table 7 – Idaho agricultural production ranking .....	7
Table 8 – Idaho whey and lactose production .....	9
Table 9 – Whey powder historical prices for the Central U.S. region.....	16
Table 10 – 10-Year Average Idaho Corn Prices (\$/bushel).....	17
Table 11 – 10-Year Average Idaho Barley Prices (\$/bushel).....	18
Table 12 – 10-Year Average Idaho Potato Prices (\$/cwt) .....	18
Table 13 – 10-Year Average Idaho Sugarbeet Prices (\$/ton).....	18
Table 14 – Ethanol potential from Idaho wheat, barley and corn.....	20
Table 15 – Ethanol potential for the Southeast Ethanol plant .....	23
Table 16 – Ethanol potential for the South Central Ethanol plant.....	23
Table 17 – Ethanol potential for the Southwest Ethanol plant .....	24
Table 18 – Ethanol potential for the Panhandle Ethanol plant .....	24
Table 19 – Hypothetical Idaho ethanol production plants .....	26
Table 20 – Capital cost estimates for hypothetical ethanol plants in Idaho.....	27
Table 21 – Estimated operating costs and direct jobs for proposed ethanol plants .....	28
Table 22 – Economic impact analysis inputs for Idaho ethanol plants.....	31
Table 23 – Economic impacts of ethanol production in Idaho .....	32
Table 24 – Estimated tax impacts of ethanol production in Idaho .....	33
Table 25 – Grain utilized and value of distillers grain (DG) in proposed ethanol plants. 34	
Table 26 – Value added to Idaho grains by ethanol production .....	34

## List of Figures

Figure 1 – Idaho ethanol production potential by county .....	2
Figure 2 – Idaho wheat production .....	10
Figure 3 – Idaho corn production.....	11
Figure 4 – Idaho barley production.....	12
Figure 5 – Idaho sugarbeet production .....	13
Figure 6 – Idaho potato production.....	14
Figure 7 – Total production of five field crops.....	15
Figure 8 – Historical Idaho wheat prices (USDA data).....	17
Figure 9 – Idaho ethanol production potential by county .....	21
Figure 10 – Ethanol plant sites for the economic impact study.....	22

## I. EXECUTIVE SUMMARY

The Idaho Department of Water Resources has retained BBI International (BBI) to carryout an assessment of the economic impacts associated with new ethanol production in Idaho. The objective of this assessment is to determine the economic benefits to the State and the return on investment to the State of any existing or proposed State ethanol incentives. This study does not evaluate the feasibility of ethanol production in Idaho, but rather the resulting economic impacts if ethanol plants are built and operated in the state.

Idaho is blessed with great resources for agriculture and is ranked in the top ten in the United States for 18 crops. The crops that were evaluated for ethanol production in Idaho include wheat, barley, corn, sugarbeets, potatoes and whey. Other feedstocks such as hay, grasses, wood and other forms of biomass can be used to produce ethanol, but the technologies to convert “cellulosic” biomass to ethanol are not yet commercial so these feedstocks were not included in the current study.

Production of the major starch and sugar crops in Idaho (plus whey) is shown in the table below. Five or six year average production data is shown with 10-year average price data. Wheat, corn and barley are price in a range that would be competitive with Midwest corn. The price for sugarbeets, potatoes and whey are too high for these feedstocks to be competitive with ethanol produced from Midwest corn.

**Table 1 – Potential ethanol feedstock production and pricing data**

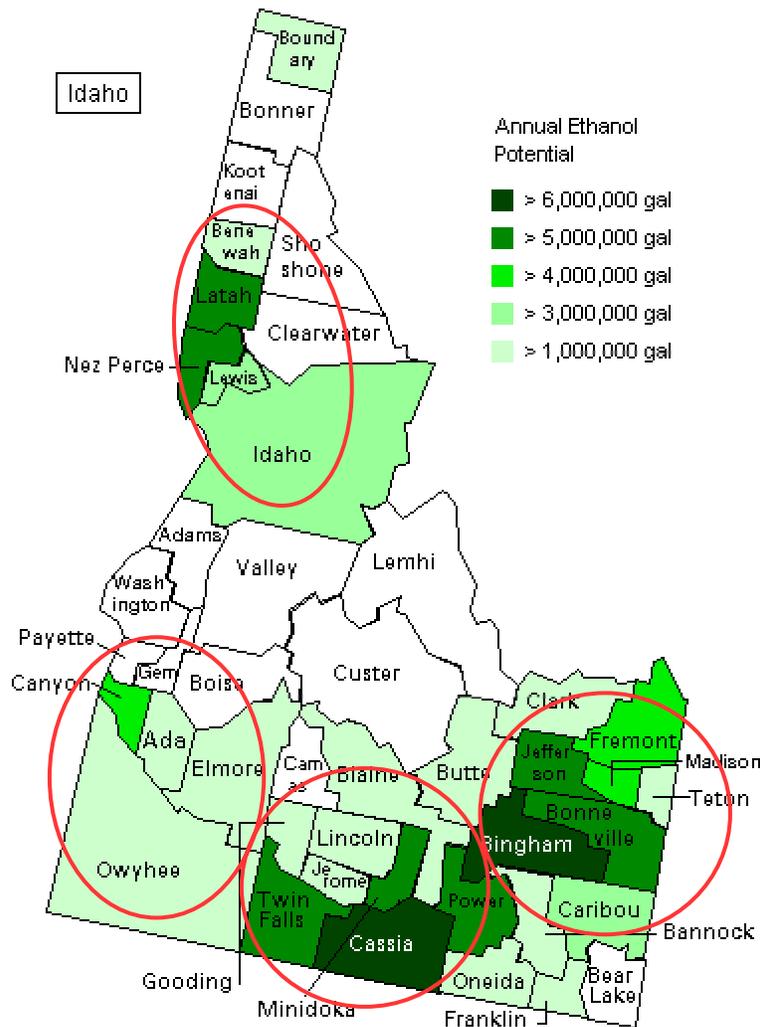
<b>Ethanol Feedstock</b>	<b>Average Production</b>	<b>Average Price</b>
Wheat	105 million bushels	\$3.27 per bushel
Barley	55 million bushels	\$2.72 per bushel
Corn	6.7 million bushels	\$2.94 per bushel
Sugarbeets	5.4 million tons	\$4.82 per cwt
Potatoes	142 million tons	\$40.68 per ton
Whey	37,572 tons	21.5¢ per pound

Ethanol production potentials were estimated for each Idaho County based on the average production of wheat, barley and corn from 1996 through 2001. The results are shown in Figure 1. We have assumed that 25% of the corn, barley and wheat production is available for ethanol production. This is a reasonable assumption used for Midwest ethanol projects and may result in a slight increase in local grain prices.

Statewide approximately 107 million gallons of ethanol could be produced using 25% of the wheat, barley and corn produced in each Idaho county. The map below shows the ethanol potential by county. The red circles on the Figure 1 map are the approximate

locations assumed for the ethanol plants for this study. Each red circle is a feedstock collection area of approximately 65 miles in radius. The feedstock areas shown in the map below are centered on the regions in the state with the highest concentrations of wheat, barley and corn. Other feedstocks within these areas such as potato waste and whey, as well as feedstocks from across state lines may supplement the primary Idaho feedstocks, but were not considered in the sizing of the ethanol facilities for this study. Site specific studies would be required to determine the optimum feedstock mix for each ethanol plant site.

**Figure 1 – Idaho ethanol production potential by county**



The four potential ethanol plants will be referred to as Southeast, South Central, Southwest and the Panhandle area ethanol plants. The amount of wheat, barley and corn feedstocks within each feedstock area was determined and the resulting ethanol plant size calculated based on using 25% of the local grain production.

The table below summarizes the feedstock requirement and ethanol capacities for the four hypothetical ethanol plants.

**Table 2 – Hypothetical Idaho ethanol production plants**

<b>Location</b>	<b>Wheat Feedstock (bushels/year)</b>	<b>Barley Feedstock (bushels/year)</b>	<b>Corn Feedstock (bushels/year)</b>	<b>Nameplate Capacity (gallons)</b>
<b>Southeast</b>	8,028,471	6,771,125	5,000	37,000,000
<b>South Central</b>	8,064,925	3,974,459	658,500	32,000,000
<b>Southwest</b>	2,410,729	501,458	976,000	10,000,000
<b>Panhandle</b>	6,168,550	1,346,708	0	20,000,000

The estimated capital costs, operating costs and direct jobs for each ethanol plant are shown in Table 3 below. Capital cost estimates for the hypothetical ethanol plants vary from about \$23 million for the 10 million gallon per year Southwest ethanol plant to \$51 million for the 37 million gallon per year Southeast plant. The capital costs include both the hard costs to design, purchase and install the ethanol plant equipment and the soft costs, which include land, site development, utilities, financing costs, startup costs and beginning inventories. The costs shown are for typical dry mill ethanol plants. Actual costs for ethanol plants in Idaho may be different than the costs shown due to site conditions and other design issues.

Operating costs include feedstocks, chemicals, natural gas, electricity, water, production labor, administrative and operating expenses and financing costs. Annual operating costs vary from \$18 million for the Southwest plant to \$61 million for the Southeast plant.

**Table 3 – Capital and operating cost estimates for Idaho ethanol plants**

<b>Plant Location</b>	<b>Southeast</b>	<b>South Central</b>	<b>Southwest</b>	<b>Panhandle</b>
Ethanol Production (millions of gallons)	37	32	10	20
Ethanol Plant Capital Cost (millions)	\$50.8	\$46.0	\$22.6	\$34.1
Annual Operating Expenditures (millions)	\$61.0	\$53.0	\$18.2	\$34.4
Ethanol Plant Direct Jobs	38	36	24	28

Construction and operation of ethanol plants in Idaho will create significant economic activity in local communities where the production facilities are located. Ethanol plant construction and operation will involve expenditures, income, employment and payment of taxes. The expenditures of any business become the income of other businesses or

individuals, which in turn is re-spent in the economy to provide income for others. Thus the initial economic activity has a multiplier effect that ripples through the economy.

The final demand, household earnings and job impacts were estimated by applying the appropriate final demand multipliers calculated by the U.S. Bureau of Economic Analysis for output, earnings and employment to the estimates of new capital spending and annual operating expenditures associated with the proposed ethanol plants. The resulting economic impacts are reported in Table 4 as estimated changes in the economic base (final demand), income and jobs resulting from ethanol production in Idaho.

The construction spending associated with building the four ethanol plants in Idaho will add approximately \$373 million to the final demand in the local economy and generate \$121 million in new household income and provide for 3,777 direct and indirect jobs during construction of the four hypothetical ethanol plants.

During the operations phase, the four ethanol plants will create nearly 1,900 new jobs and add approximately \$327 million to the final demand in the local economy. New household income will be approximately \$58 million annually. Annual state tax revenue is estimated to be \$4.54 million on the new earnings.

**Table 4 – Economic impacts of ethanol production in Idaho**

<b>Construction Phase Impacts</b>	<b>Southeast</b>	<b>South Central</b>	<b>Southwest</b>	<b>Panhandle</b>
Ethanol Plant Capital Cost (millions)	\$50.8	\$46.0	\$22.6	\$34.1
Final Demand Impact (millions)	\$123.2	\$111.7	\$54.9	\$82.7
Personal Earnings Impact (millions)	\$40.0	\$36.2	\$17.8	\$26.8
Employment Impacts (direct and indirect jobs)	1,249	1,132	557	839

<b>Operations Phase Impacts</b>	<b>Southeast</b>	<b>South Central</b>	<b>Southwest</b>	<b>Panhandle</b>
Local Spending (millions)	\$61.0	\$53.0	\$18.2	\$34.4
Final Demand Impact (millions)	\$119.8	\$104.0	\$35.7	\$67.5
Personal Earnings Impact (millions)	\$21.3	\$18.5	\$6.3	\$12.0
Employment Impacts (direct jobs)	38	36	24	28
Employment Impacts (indirect jobs)	645	560	192	363
Total Jobs (direct + indirect)	683	596	216	391

The operation of ethanol facilities in Idaho will potentially generate corporate as well as personal income tax revenues for both the federal and state governments. The projected tax revenues are shown in Table 5. The tax revenues shown are estimates only and will depend upon the profitability of the ethanol plant and possible parent companies.

The state producer payments shown in Table 5 are to demonstrate the potential return to the State only -- the producer payments are hypothetical and are currently not provided by Idaho statute. We have assumed that the payments are capped at \$2 million per year per ethanol facility. For this example the producer payments, which total \$7.9 million per year, are offset by the \$11.3 million in increased State and Federal tax revenue.

**Table 5 – Estimated tax impacts of ethanol production in Idaho**

<b>Tax Impacts (millions)</b>	<b>Southeast</b>	<b>South Central</b>	<b>Southwest</b>	<b>Panhandle</b>
Personal Earnings Impact (note 1)	\$21.3	\$18.5	\$6.3	\$12.0
Idaho Income Tax on Personal Earnings (note 2)	\$1.7	\$1.4	\$0.5	\$0.9
Average Ethanol Plant Pre-Tax Income (note 3)	\$6.1	\$4.9	\$2.0	\$3.7
State & Federal Corporate Income Tax Revenue (note 4)	\$2.5	\$2.0	\$0.8	\$1.5
Total Tax Revenue (millions)	\$4.1	\$3.4	\$1.3	\$2.5
State Producer Payment (note 5)	\$2.0	\$2.0	\$1.9	\$2.0
Annual Return to State (millions)	\$2.1	\$1.4	(\$0.6)	\$0.5

Notes:

1. The Personal Earnings Impact includes direct and indirect personal earnings resulting from the operation of four ethanol plants in Idaho.
2. Idaho personal income tax rate is 7.8%.
3. Average Ethanol Plant Pre-Tax Income estimated by BBI based on ethanol feasibility studies conducted in Idaho and throughout the Midwest.
4. A combined state and federal corporate income tax rate of 41% has been assumed.
5. State Producer Payments are hypothetical and are assumed to be capped at \$2 million per year per Idaho ethanol facility. Producer Payments are currently not provided in Idaho.

Value added to the wheat, barley and corn feedstocks at the local level is another reason to produce ethanol in Idaho. There are over 105 million bushels of wheat, 55 million bushels of barley and nearly 7 million bushels of corn produced in Idaho each year. Much of these grains are exported out of the state.

Table 6 illustrates the economic impact on the value added to the Idaho grains processed by the ethanol facilities. The ethanol price and grain cost are based on USDA data as well

as information from the BBI database. The value added to grain benefiting the State of Idaho is approximately \$0.71 per bushel, or \$27.6 million annually.

**Table 6 – Value added to Idaho grains by ethanol production**

<b>Product</b>	<b>Annual Quantity</b>	<b>Price</b>	<b>Revenue (Cost)</b>	<b>Revenue per bushel</b>
Ethanol	99 million gallons	\$1.30/gal	\$128,700,000	\$3.31
Distillers Grain	362,300 tons	\$120/ton	\$43,476,000	\$1.12
Grain	38,906,000 bushels	\$2.83/bu	(\$110,103,980)	(\$2.83)
Production Costs			(\$34,471,049)	(\$0.89)
<b>Value Added</b>			<b>\$27,600,971</b>	<b>\$0.71</b>

Notes:

1. It is assumed that the DG will be sold in the State of Idaho to local dairies or other users.
2. The sale of carbon dioxide (CO<sub>2</sub>) has not been estimated for this analysis in order to be conservative and not draw any conclusions as to the local markets for CO<sub>2</sub>.
3. Production costs were estimated by BBI based on previous ethanol feasibility studies in Idaho.

Ethanol production holds the potential to bring significant economic development to Idaho while adding value to local crops that are currently exported out of the state. The analysis of the available feedstocks presented herein, indicate that Idaho wheat, barley and corn could support approximately 100 million gallons of annual ethanol production. Four ethanol plants with this combined capacity would create nearly 3,800 jobs during construction and about 1,900 permanent jobs during commercial operation of the facilities. Total resulting state and federal tax revenue is estimated to be \$11.3 million annually.

## II. INTRODUCTION

The Idaho Department of Water Resources has retained BBI International (BBI) to carryout an assessment of the economic impacts associated with new ethanol production in Idaho. The objective of this assessment is to determine the economic benefits to the State and the return on investment to the State of any existing or proposed State ethanol incentives. This study does not evaluate the feasibility of ethanol production in Idaho, but rather the resulting economic impacts if ethanol plants are built and operated in the state.

**Table 7 – Idaho agricultural production ranking**

Idaho is blessed with great resources for agriculture and is ranked in the top ten in the Nation for 18 crops, (see Table 7) plus trout, American cheese, milk, sheep, lambs and wool. The Idaho field crops that could be used for ethanol production include potatoes, barley, sugarbeets, wheat and corn. A significant amount of dairy whey is also potentially available for ethanol production. Other crops and feedstocks such as hay, grasses and other forms of biomass can be used to produce ethanol, but the crops listed above are judged by BBI to be the most realistic for ethanol production in the near-term.

<b>Idaho's Rank in the Nation's Agriculture in 2001</b>		
<b>Commodity</b>	<b>Rank Among States</b>	<b>% of U.S.</b>
Potatoes	1	29
Austrian Winter Peas	1	70
Wrinkled Seed Peas	2	32
Lentils	2	27
Barley	2	20
Sugar Beets	2	18
Dry Edible Peas	3	12
Hops	3	7
All Mint	3	14
Onions (Summer Storage)	3	14
Prunes and Plums	4	18
Other Spring Wheat	5	7
Dry Edible Beans	6	7
Sweet Corn/Processing	6	4
Alfalfa Hay	6	5
Sweet Cherries	6	1
All Wheat	7	4

To determine the State ethanol production potential, BBI evaluated historical crop production and pricing data for the feedstocks of interest (potatoes, barley, sugarbeets, wheat, corn and whey) and then selected hypothetical ethanol plant sites based on regional crop production and pricing. Specific plant sites were not determined, but rather general areas were identified where an ethanol plant would have access to Idaho feedstocks within a reasonable transportation distance. The appropriate ethanol plant production capacities were determined for each site based on the availability of feedstock within a reasonable feedstock collection area – generally about 50 miles.

Once the number and size of ethanol plants was determined, BBI then estimated the capital and operating costs for each ethanol plant at the study sites. Multipliers were then applied to each potential ethanol project to assess the economic impact of the project. The following economic impacts were estimated:

- Economic activity and job creation (for both construction and operational phases for each study site)
- Capital investment in ethanol plant and equipment
- Value added to local feedstocks
- Corporate and personal income tax revenues (Federal and State)
- Return on ethanol incentive(s) to the State of Idaho

The hypothetical ethanol plant sites discussed in this report were selected based on the local feedstock production and pricing. In addition to feedstock issues, there are many other criteria that must be considered when siting an ethanol plant, however. Good road and rail access are necessary for receiving feedstock supplies and shipping products, utility availability and pricing can impact the facility capital and operating costs, and space for equipment and truck movement are necessary. Other considerations include distance to markets, the size and strength of the local distillers grain market, a qualified and/or trainable labor force, as well as community facilities that are capable of attracting and retaining top management personnel who may come from outside the area. Access to an airport is important as well as good medical facilities. Large cattle feedlots, dairies and other potential users of the distillers grain co-product near a site would allow for feeding of wet distillers grains to cattle, resulting in significant energy savings.

Again, when selecting an ethanol plant site it is important to consider all of the factors that will impact the project risk, capital cost and operation of the ethanol facility and ultimately impact the success of the venture.

### III. FEEDSTOCK PRODUCTION AND PRICING

Nationwide, Idaho is ranked first in potato production, second in sugarbeet and barley production, and seventh in overall wheat production. Feedstocks to be evaluated in this study include Idaho wheat, corn, barley, sugarbeets, potatoes and dairy whey. Wheat, corn, barley, sugarbeets and potato data was obtained from the USDA National Agricultural Statistics Service (<http://www.usda.gov/nass/>). Data for whey was provided by the State of Idaho.

#### Feedstock Production

Historical crop production data was used to develop maps showing the Idaho counties with the highest crop production. These maps allow one to visualize where the various feedstocks are produced in the state and to identify general areas where ethanol plants might be located based on Idaho's feedstock production. An Idaho ethanol plant may import feedstock from neighboring states, but this was not considered here. Also as discussed previously, other factors will dictate the best sites for an ethanol plant in Idaho.

#### Whey

Whey, a byproduct of cheese-making, is a commodity used to make processed foods, animal feeds and supplements. Approximately half of the liquid whey produced in the United States is further processed to whey powder, whey protein concentrate, whey protein isolate, reduced-lactose whey and reduced-mineral whey. A significant amount of processed whey is exported. Idaho dairies produce from 35,000 to 40,000 tons of dry whey each year. Production from 1997 through 2001 is shown in Table 8. Dry whey contains about 70% lactose, which is the fermentable portion of the whey.

Table 8 – Idaho whey and lactose production

	Dry Whey	Dry Whey	Lactose
Year	(lbs)	(tons)	(tons)
2001	79,087,476	39,544	27,681
2000	81,343,068	40,672	28,470
1999	78,128,975	39,064	27,345
1998	71,575,278	35,788	25,051
1997	65,595,069	32,798	22,958
<b>Average</b>	<b>75,145,973</b>	<b>37,573</b>	<b>26,301</b>

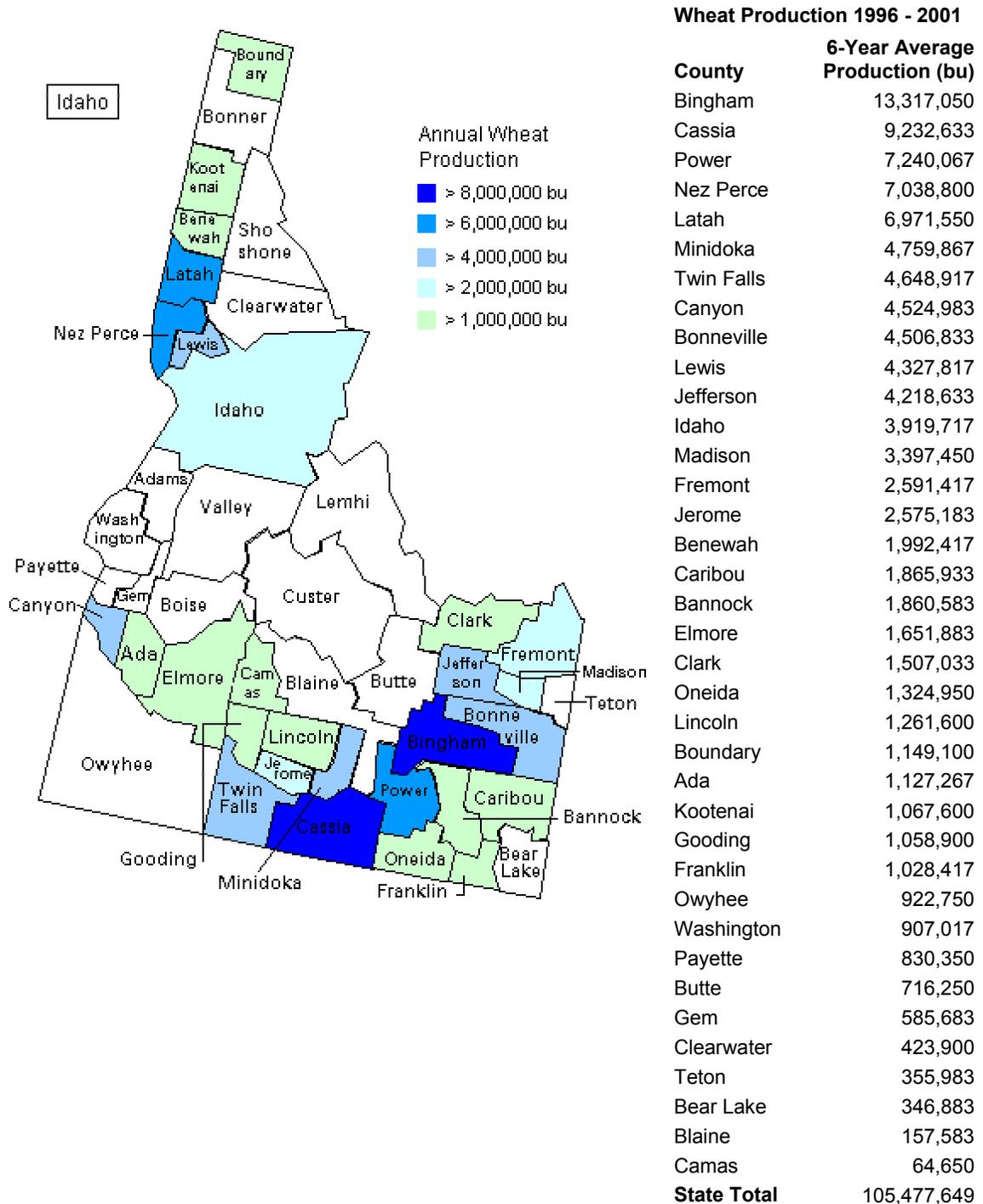
Notes: Dry whey contains approximately 70% lactose

#### Wheat

Wheat is the third largest field crop in Idaho behind potatoes (7.5 million tons per year) and sugarbeets (4.6 million tons per year). Annual wheat production in Idaho averaged 105 million bushels per year from 1996 to 2001 or 3.2 million tons of wheat.

The top wheat producing counties in Idaho are shown in the following table and map. Bingham and Cassia counties have the highest average annual wheat production at about 13 million bushels per year in Bingham county and 9 million bushels per year in Cassia county. Power, Nez Perce and Latah counties all average about 7 million bushels per year. Wheat production tends to be concentrated in the southeast part of the state.

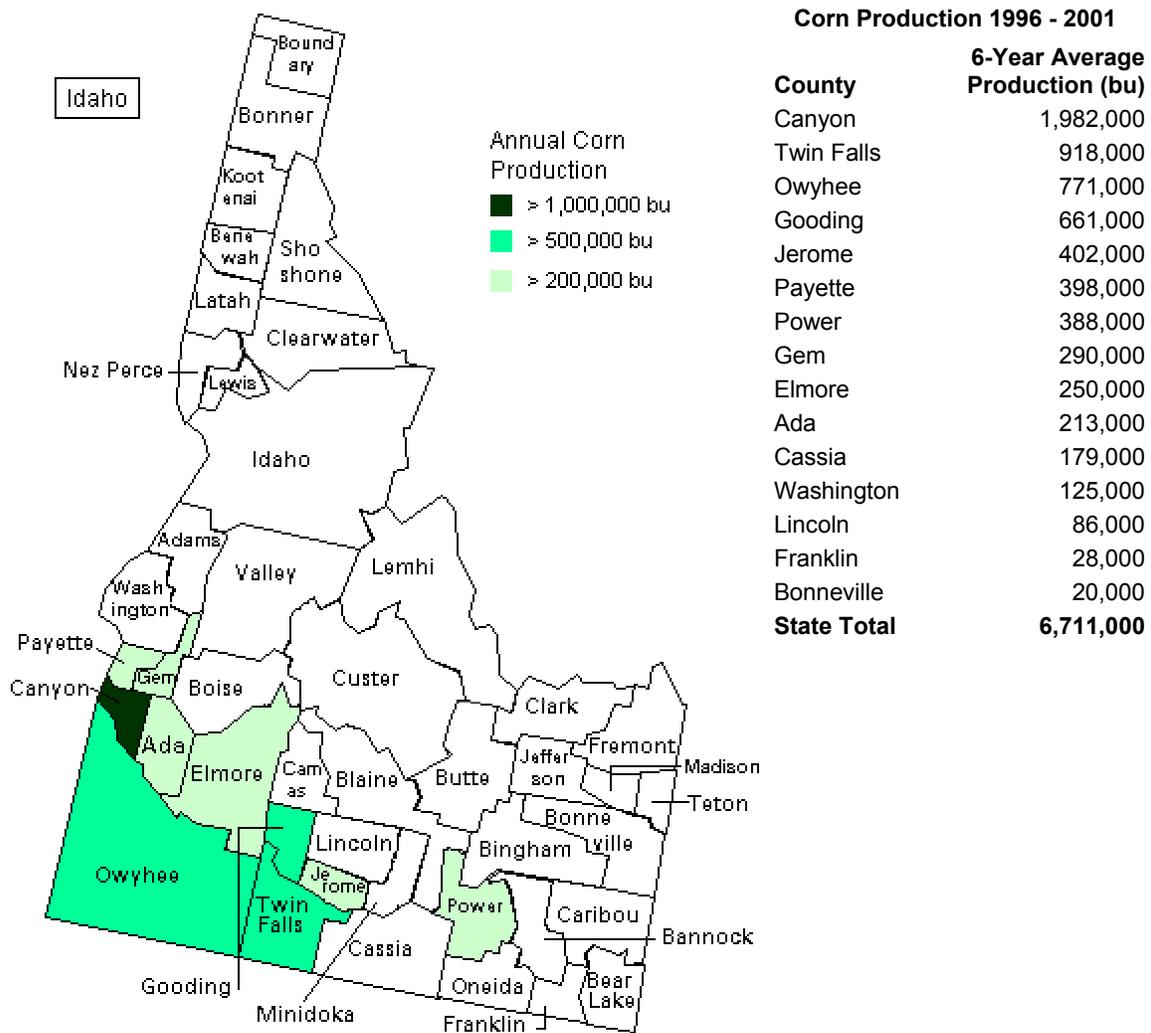
**Figure 2 – Idaho wheat production**



## Corn

Corn production in Idaho is relatively limited with only 6.7 million bushels produced annually on average from 1996 through 2001. Corn is grown primarily in the southwest corner of the state – Canyon, Owyhee, Twin Falls and Gooding counties produce about 65% of the state’s corn. The top corn producing counties in Idaho are shown in the following table and map.

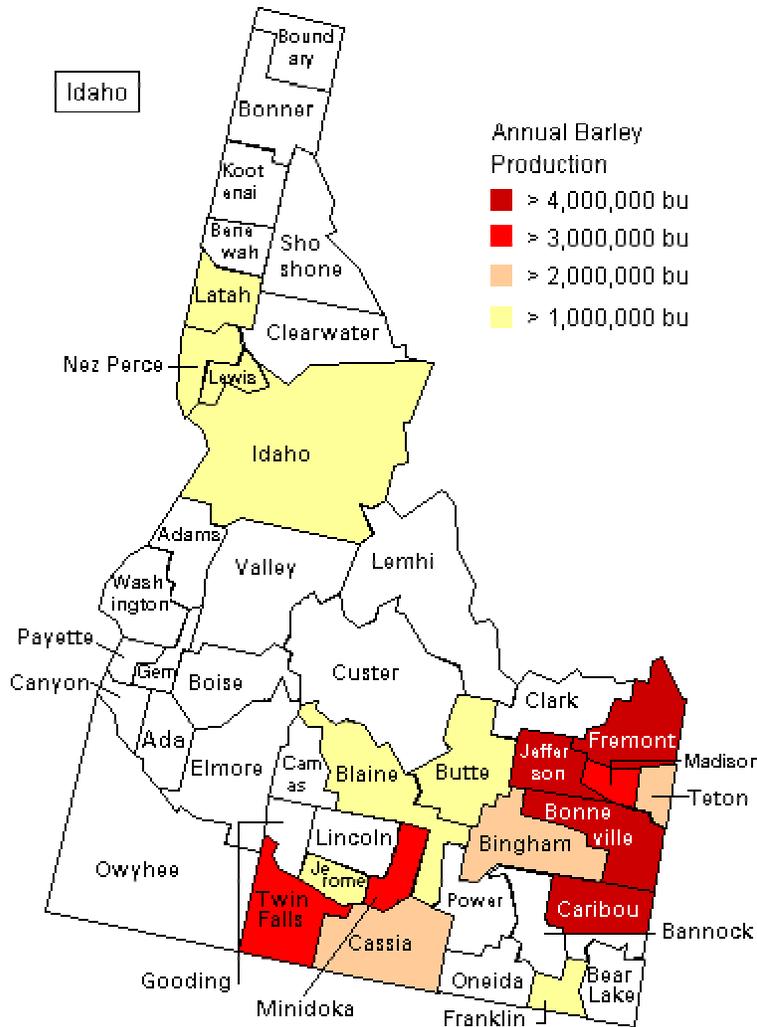
Figure 3 – Idaho corn production



## Barley

Barley production in Idaho averaged 55 million bushels per year from 1996 through 2001. Idaho ranks number two in barley production behind North Dakota with 80 million bushels of barley produced in 2001.

Figure 4 – Idaho barley production



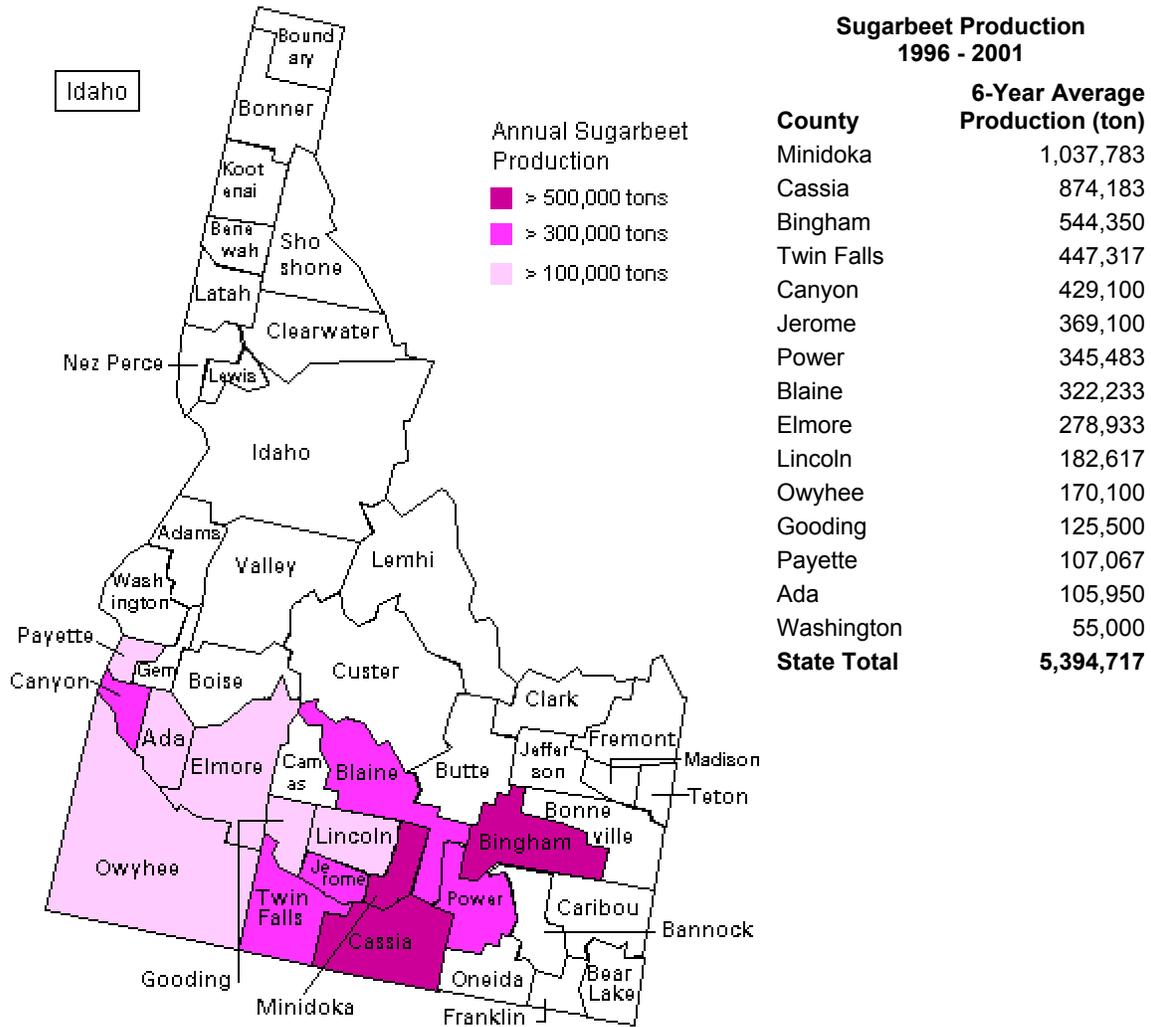
### Barley Production 1996 - 2001

County	6-Year Average Production (bu)
Bonneville	4,916,333
Caribou	4,686,333
Fremont	4,514,167
Jefferson	4,080,000
Minidoka	3,814,683
Madison	3,654,333
Twin Falls	3,608,667
Cassia	2,983,067
Teton	2,677,000
Bingham	2,067,667
Blaine	1,696,783
Jerome	1,599,833
Butte	1,348,500
Idaho	1,334,500
Nez Perce	1,237,333
Lewis	1,230,333
Franklin	1,096,667
Latah	1,076,500
Lincoln	832,167
Canyon	775,167
Bear Lake	697,333
Oneida	655,000
Bannock	488,667
Boundary	479,167
Camas	388,833
Power	376,167
Owyhee	363,833
Gooding	331,467
Elmore	296,000
Benewah	262,333
Ada	260,400
Clearwater	245,833
Gem	208,683
Clark	185,550
Washington	183,750
Custer	169,667
Kootenai	164,633
Payette	101,750
<b>State Total</b>	<b>55,089,099</b>

## Sugarbeet

Sugarbeets are the second largest field crop in Idaho with about 5.4 million tons produced each year on average from 1996 through 2001. Idaho sugarbeet production is concentrated in the south-central part of the state with Twin Falls, Cassia, Minidoka, and Bingham counties accounting for about 54% of the state's production. Idaho sugarbeet production is shown in the following map and table.

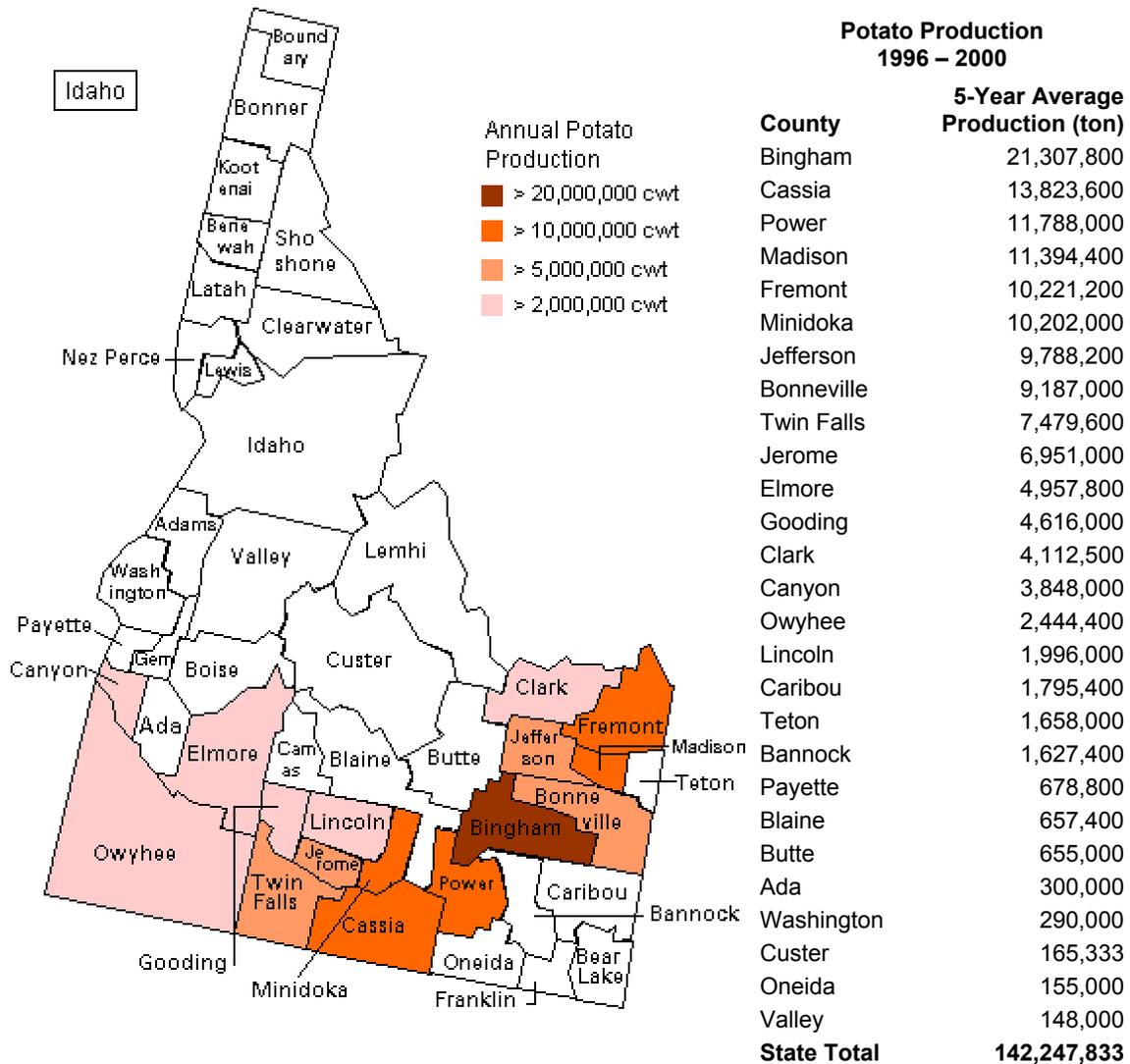
**Figure 5 – Idaho sugarbeet production**



## Potato

Potatoes are the number one field crop in Idaho with an average of 142 million hundred weight (cwt) or 7.1 million tons produced each year from 1996 through 2000. Potato production is highest in the south-central and southeast Idaho counties. Bingham county produces the most potatoes with Cassia, Minidoka, Power, Jefferson, Madison and Fremont producing the majority of the balance of production.

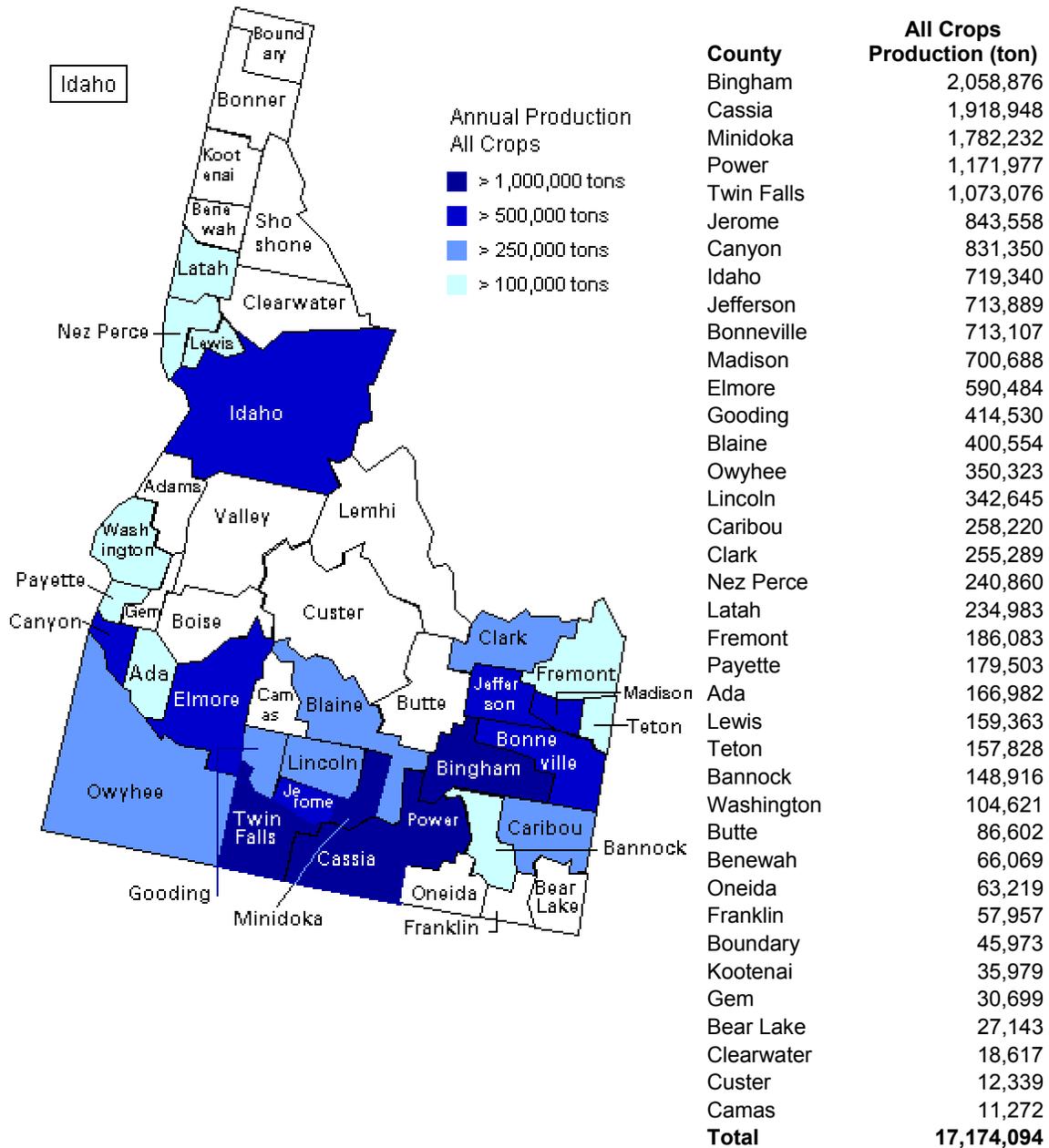
Figure 6 – Idaho potato production



## Total Crop Production

When all five field crops of interest are converted to average annual tons produced by county, the following map is obtained. As expected, the majority of wheat, corn, barley, sugarbeets and potatoes are produced in the south central and southeast counties of the state. Bingham county has the highest production at over 2 million tons of wheat, barley, sugarbeets and potatoes grown each year. Cassia, Minidoka and Power counties rank, 2, 3 and 4 with 1.9 million, 1.8 million and 1.2 million tons of field crops produced each year.

Figure 7 – Total production of five field crops



## Feedstock Pricing

Feedstock cost is important to consider when estimating the amount of ethanol that could be reasonably produced from Idaho field crops and dairy whey. If the feedstocks are priced too high, ethanol production will not be competitive. Historical pricing for dairy whey, wheat, corn, potatoes and sugar beets will be examined to determine if these feedstocks can be reasonably expected to be used for ethanol production in Idaho.

## Whey

Whey pricing was obtained from the USDA Agricultural Marketing Services *Dairy Market News*. The *Dairy Market News* covers the supply, demand and pricing on a regional, national, and international basis for milk, butter, cheese and dry and fluid products. Whey is sold as a liquid, condensed liquid and a dry powder. Whey powder is by far the most common product sold. Historical pricing for whey powder in the U.S. Central region is shown in Table 9 below. The 10-year average price for whey powder in the Central region was about \$0.215 per pound.

**Table 9 – Whey powder historical prices for the Central U.S. region**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1992	0.218	0.197	0.209	0.228	0.241	0.215	0.200	0.206	0.209	0.204	0.170	0.159
1993	0.169	0.192	0.196	0.178	0.159	0.171	0.171	0.162	0.173	0.200	0.219	0.217
1994	0.198	0.203	0.219	0.210	0.185	0.185	0.195	0.196	0.196	0.191	0.184	0.182
1995	0.178	0.172	0.189	0.198	0.188	0.174	0.184	0.205	0.226	0.252	0.279	0.286
1996	0.255	0.231	0.231	0.234	0.217	0.220	0.225	0.243	0.243	0.219	0.183	0.188
1997	0.192	0.205	0.211	0.188	0.181	0.191	0.216	0.227	0.250	0.321	0.328	0.332
1998	0.284	0.243	0.239	0.227	0.230	0.258	0.279	0.282	0.284	0.251	0.247	0.245
1999	0.203	0.188	0.186	0.173	0.164	0.174	0.181	0.197	0.208	0.194	0.183	0.187
2000	0.181	0.175	0.177	0.173	0.176	0.187	0.197	0.180	0.175	0.182	0.211	0.253
2001	0.272	0.251	0.239	0.250	0.268	0.295	0.296	0.279	0.293	0.290	0.298	0.302
2002	0.269	0.214	0.196	0.185	0.169	0.155	0.157					
<b>Avg.</b>	<b>0.220</b>	<b>0.206</b>	<b>0.208</b>	<b>0.204</b>	<b>0.198</b>	<b>0.202</b>	<b>0.209</b>	<b>0.218</b>	<b>0.226</b>	<b>0.230</b>	<b>0.230</b>	<b>0.235</b>

One pound of whey powder will yield about 0.048 gallon of ethanol. At 21.5¢ per pound of whey powder, the cost of the whey feedstock per gallon of ethanol produced is \$4.50. Whey powder is much too expensive to be used for ethanol production. Liquid whey may be available for much lower cost, but liquid whey contains only 4 or 5% lactose making it a very unattractive feedstock for fuel ethanol production because of the increased energy and equipments costs due to the low sugar concentration. Wastewater treatment can also be a serious issue for an ethanol plant with lactose feedstock.

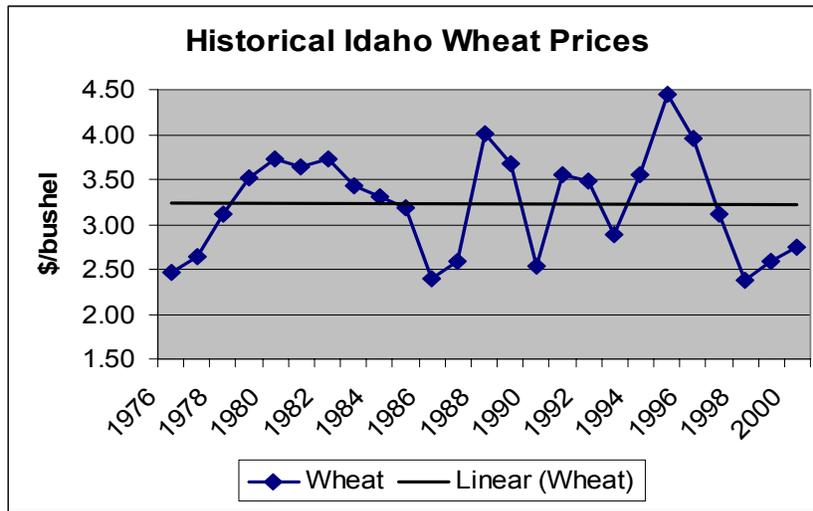
Brewers yeast used to make ethanol will not ferment lactose. A different yeast strain such as *Kluyveromyces marxianus* must be used to convert lactose to ethanol or a lactase enzyme must be used to convert the lactose to glucose. In either case the lactose cannot

be simply added to the ethanol production process without significant modification. Integration of whey/lactose into a standard dry mill ethanol plant is not practical.

## Wheat

Idaho wheat prices from 1976 through 2000 are shown in the chart below. The average wheat price in Idaho for the past twenty-five years was \$3.23 per bushel. The 10-year (1991 through 2000) average price was \$3.27 per bushel. For the past three years, wheat prices in Idaho have been well below \$3.00 per bushel, but as shown by the trend line in the chart below, Idaho wheat prices have remained, on average, unchanged for 25 years.

Figure 8 – Historical Idaho wheat prices (USDA data)



At \$3.27 per bushel and 2.74 gallons of ethanol per bushel of wheat, the cost of wheat feedstock for ethanol production is about \$1.20 per gallon. While this is higher than the typical cost for corn for ethanol production in the Midwest, it is not unreasonable to include wheat in the estimate of potential ethanol production in Idaho.

## Corn

Historical Idaho corn prices are shown in Table 10. The 10-year average price of corn in Idaho is \$2.94 per bushel. The average price of Idaho corn for the past five years was only \$2.62 per bushel, however.

Table 10 – 10-Year Average Idaho Corn Prices (\$/bushel)

1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Avg.
\$2.65	\$3.15	\$2.76	\$4.50	\$3.25	\$3.03	\$2.55	\$2.34	\$2.63	\$2.55	\$2.94

Source: USDA National Agricultural Statistics Service

At \$2.94 per bushel and 2.8 gallons of ethanol per bushel of corn, the cost of Idaho corn feedstock for ethanol production is about \$1.05 per gallon. While this is higher than the

typical cost of corn for ethanol production in the Midwest, it is not unreasonable to include corn in the estimate of potential ethanol production in Idaho.

## Barley

Historical Idaho barley prices are shown in Table 11. The 10-year average price of barley in Idaho is \$2.72 per bushel and the five year average was \$2.63 per bushel.

**Table 11 – 10-Year Average Idaho Barley Prices (\$/bushel)**

1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Avg.
\$2.81	\$2.64	\$2.42	\$3.05	\$3.14	\$2.82	\$2.40	\$2.60	\$2.59	\$2.75	\$2.72

Source: USDA National Agricultural Statistics Service

At \$2.72 per bushel and 2.2 gallons of ethanol per bushel of barley, the cost of Idaho barley feedstock for ethanol production is about \$1.24 per gallon. While this is higher than the typical cost of corn for ethanol production in the Midwest, it is not unreasonable to include barley in the estimate of potential ethanol production in Idaho.

## Potato

From 1992 through 2001, Idaho potatoes have averaged \$4.82 per hundred weight (cwt). Potatoes contain only about 16% starch with the balance being mostly water. 100 pounds of potatoes will produce about 1.2 gallons of ethanol. At \$4.82 per cwt, just the feedstock cost for potatoes will be nearly \$4.00 per gallon of ethanol. Potatoes are clearly too expensive (and the starch content too low) for economical fuel ethanol production. Potato wastes may be suitable for ethanol production in Idaho, but potatoes themselves are too expensive to be considered a primary feedstock for fuel ethanol production.

**Table 12 – 10-Year Average Idaho Potato Prices (\$/cwt)**

1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Avg.
\$5.15	\$4.65	\$4.95	\$6.20	\$3.85	\$4.50	\$4.55	\$4.95	\$4.00	\$5.40	\$4.82

Source: USDA National Agricultural Statistics Service

## Sugarbeets

From 1992 through 2000 Idaho sugar beets have averaged \$40.68 per ton. Sugar beets will yield about 22.1 gallons of ethanol per ton. At \$40.68 per ton, the feedstock cost for sugar beets will be about \$1.85 per gallon of ethanol. Sugar beets are too expensive for economical fuel ethanol production.

**Table 13 – 10-Year Average Idaho Sugarbeet Prices (\$/ton)**

1992	1993	1994	1995	1996	1997	1998	1999	2000	Avg.
\$39.60	\$41.20	\$38.00	\$40.50	\$46.10	\$40.60	\$39.90	\$42.30	\$37.90	\$40.68

Source: USDA National Agricultural Statistics Service

## **IV. ETHANOL PRODUCTION POTENTIAL**

Estimates of the ethanol production potential for Idaho feedstocks are based on the availability and price of potential feedstocks. As discussed in the previous section, corn, barley and wheat appear to be competitively priced compared to Midwest corn for ethanol production. Idaho potatoes, sugar beets and whey powder are all too expensive to be considered for ethanol production in today's marketplace.

Not all of the Idaho corn, barley and wheat can be assumed to be available for ethanol production. This would create a substantial increase in local demand and would likely drive grain prices to uncompetitive levels. We have assumed that 25% of the Idaho corn, barley and wheat production is available for ethanol production. This is a reasonable assumption used for Midwest ethanol projects and may result in a slight increase in local grain prices.

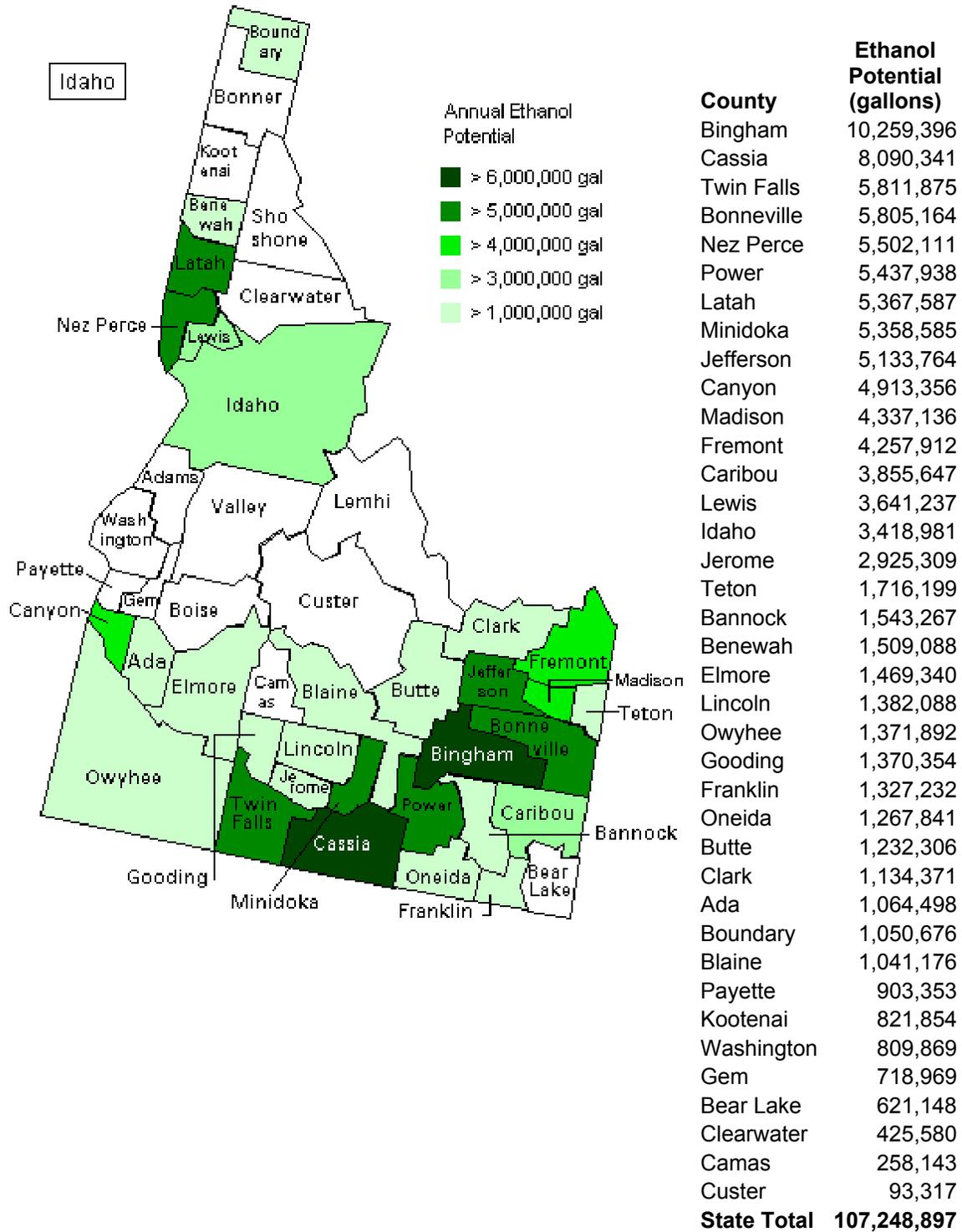
Average (1996-2001) wheat, barley and corn production by county is shown in Table 14 below. Ethanol production is based on using 25% of the wheat, barley and corn production for each county. Ethanol yield for wheat is approximately 2.74 gallons per bushel (60 lbs/bushel), barley is 2.2 gallons per bushel (48 pounds per bushel) and 2.8 gallons per bushel of corn (56 lbs/bushel). These are denatured gallons of ethanol (denatured with 5% by volume gasoline).

Statewide approximately 107 million gallons of ethanol could be produced using 25% of the wheat, barley and corn produced in each Idaho county. The map below shows the ethanol potential by county. The next step will be to determine the approximate location and size of ethanol plants based on the distribution of wheat, barley and corn production in the state.

Table 14 – Ethanol potential from Idaho wheat, barley and corn

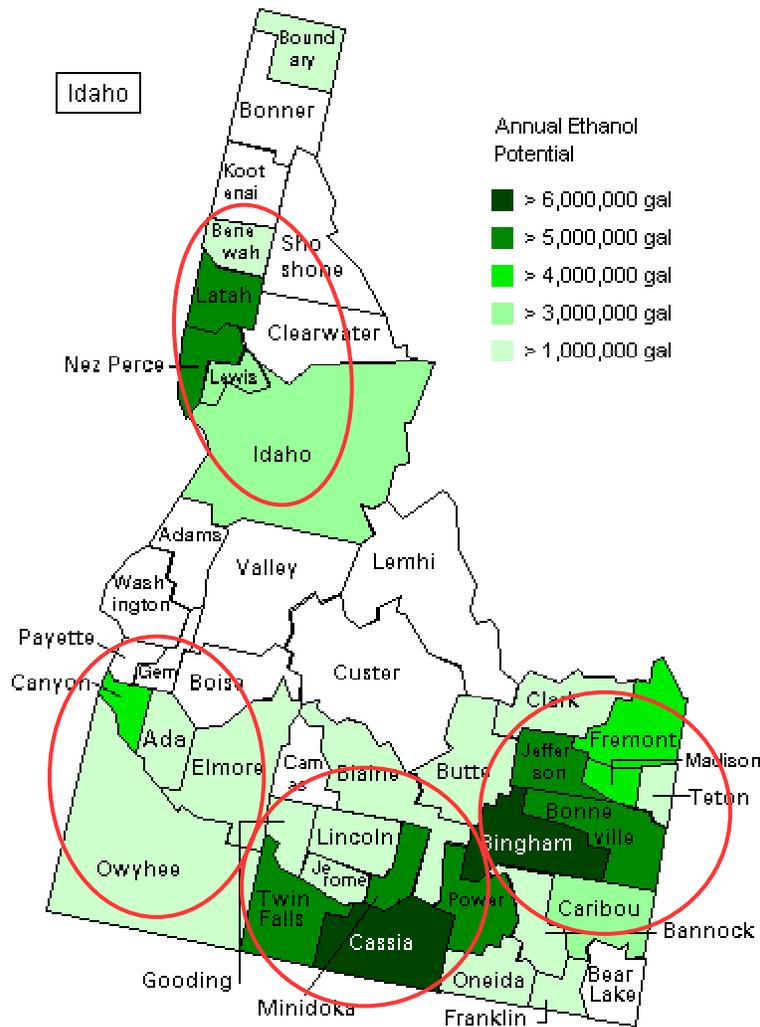
County	Wheat Production (bushels)	Wheat Available (bushels)	Wheat Ethanol (gallons)	Barley Production (bushels)	Barley Available (bushels)	Barley Ethanol (gallons)	Corn Production (bushels)	Corn Available (bushels)	Corn Ethanol (gallons)	Total Ethanol Potential (gallons)
Ada	1,127,267	281,817	772,178	260,400	65,100	143,220	213,000	53,250	149,100	1,064,498
Bannock	1,860,583	465,146	1,274,500	488,667	122,167	268,767	0	0	0	1,543,267
Bear Lake	346,883	86,721	237,615	697,333	174,333	383,533	0	0	0	621,148
Benewah	1,992,417	498,104	1,364,805	262,333	65,583	144,283	0	0	0	1,509,088
Bingham	13,317,050	3,329,263	9,122,179	2,067,667	516,917	1,137,217	0	0	0	10,259,396
Blaine	157,583	39,396	107,945	1,696,783	424,196	933,231	0	0	0	1,041,176
Bonneville	4,506,833	1,126,708	3,087,181	4,916,333	1,229,083	2,703,983	20,000	5,000	14,000	5,805,164
Boundary	1,149,100	287,275	787,134	479,167	119,792	263,542	0	0	0	1,050,676
Butte	716,250	179,063	490,631	1,348,500	337,125	741,675	0	0	0	1,232,306
Camas	64,650	16,163	44,285	388,833	97,208	213,858	0	0	0	258,143
Canyon	4,524,983	1,131,246	3,099,614	775,167	193,792	426,342	1,982,000	495,500	1,387,400	4,913,356
Caribou	1,865,933	466,483	1,278,164	4,686,333	1,171,583	2,577,483	0	0	0	3,855,647
Cassia	9,232,633	2,308,158	6,324,354	2,983,067	745,767	1,640,687	179,000	44,750	125,300	8,090,341
Clark	1,507,033	376,758	1,032,318	185,550	46,388	102,053	0	0	0	1,134,371
Clearwater	423,900	105,975	290,372	245,833	61,458	135,208	0	0	0	425,580
Custer	0	0	0	169,667	42,417	93,317	0	0	0	93,317
Elmore	1,651,883	412,971	1,131,540	296,000	74,000	162,800	250,000	62,500	175,000	1,469,340
Franklin	1,028,417	257,104	704,465	1,096,667	274,167	603,167	28,000	7,000	19,600	1,327,232
Fremont	2,591,417	647,854	1,775,120	4,514,167	1,128,542	2,482,792	0	0	0	4,257,912
Gem	585,683	146,421	401,193	208,683	52,171	114,776	290,000	72,500	203,000	718,969
Gooding	1,058,900	264,725	725,347	331,467	82,867	182,307	661,000	165,250	462,700	1,370,354
Idaho	3,919,717	979,929	2,685,006	1,334,500	333,625	733,975	0	0	0	3,418,981
Jefferson	4,218,633	1,054,658	2,889,764	4,080,000	1,020,000	2,244,000	0	0	0	5,133,764
Jerome	2,575,183	643,796	1,764,001	1,599,833	399,958	879,908	402,000	100,500	281,400	2,925,309
Kootenai	1,067,600	266,900	731,306	164,633	41,158	90,548	0	0	0	821,854
Latah	6,971,550	1,742,888	4,775,512	1,076,500	269,125	592,075	0	0	0	5,367,587
Lewis	4,327,817	1,081,954	2,964,554	1,230,333	307,583	676,683	0	0	0	3,641,237
Lincoln	1,261,600	315,400	864,196	832,167	208,042	457,692	86,000	21,500	60,200	1,382,088
Madison	3,397,450	849,363	2,327,253	3,654,333	913,583	2,009,883	0	0	0	4,337,136
Minidoka	4,759,867	1,189,967	3,260,509	3,814,683	953,671	2,098,076	0	0	0	5,358,585
Nez Perce	7,038,800	1,759,700	4,821,578	1,237,333	309,333	680,533	0	0	0	5,502,111
Oneida	1,324,950	331,238	907,591	655,000	163,750	360,250	0	0	0	1,267,841
Owyhee	922,750	230,688	632,084	363,833	90,958	200,108	771,000	192,750	539,700	1,371,892
Payette	830,350	207,588	568,790	101,750	25,438	55,963	398,000	99,500	278,600	903,353
Power	7,240,067	1,810,017	4,959,446	376,167	94,042	206,892	388,000	97,000	271,600	5,437,938
Teton	355,983	88,996	243,849	2,677,000	669,250	1,472,350	0	0	0	1,716,199
Twin Falls	4,648,917	1,162,229	3,184,508	3,608,667	902,167	1,984,767	918,000	229,500	642,600	5,811,875
Washington	907,017	226,754	621,306	183,750	45,938	101,063	125,000	31,250	87,500	809,869
<b>Total</b>	<b>105,477,649</b>	<b>26,369,416</b>	<b>72,252,193</b>	<b>55,089,099</b>	<b>13,772,275</b>	<b>30,299,004</b>	<b>6,711,000</b>	<b>1,677,750</b>	<b>4,697,700</b>	<b>107,248,897</b>

Figure 9 – Idaho ethanol production potential by county



Four potential ethanol plant sites are shown on the following map. Each red circle is a feedstock collection area of approximately 65 miles in radius. Grain feedstocks such as wheat and corn are typically transported up to 50 to 75 miles for ethanol production. The feedstock areas shown in the map below are centered on the regions in the state with the highest concentrations of wheat, barley and corn. Other feedstocks within these areas such as potato waste and whey, as well as feedstocks from across state lines may supplement the primary Idaho feedstocks, but will not be considered in the sizing of the ethanol facilities for this study. Site specific studies would be required to determine the optimum feedstock mix for each ethanol plant site.

**Figure 10 – Ethanol plant sites for the economic impact study**



The four potential ethanol plants will be referred to as Southeast, South Central, Southwest and the Panhandle area ethanol plants. The amount of wheat, barley and corn feedstocks within each feedstock area will be determined and the resulting ethanol plant size calculated based on using 25% of the local grain production. Note that the feedstock

areas do not overlap. This will minimize competition for feedstock and prevent prices from rising too high, which would make the ethanol plants less competitive.

### Southeast Ethanol Production

The Southeast Ethanol feedstock area includes the eight counties shown in Table 15. Wheat is the predominant ethanol feedstock in the area with an average of 32 million bushels produced annually from 1996 through 2001. Annual barley production averaged 27 million bushels. Corn was only reported in Bonneville county at 20,000 bushels per year. Using 25% of the average wheat, barley and corn crop results in 37 million gallons of denatured ethanol potential in the Southeast feedstock area.

**Table 15 – Ethanol potential for the Southeast Ethanol plant**

County	Wheat Production (bushels)	Wheat Ethanol (gallons)	Barley Production (bushels)	Barley Ethanol (gallons)	Corn Production (bushels)	Corn Ethanol (gallons)	Total Ethanol Potential (gallons)
Bingham	13,317,050	9,122,179	2,067,667	1,137,217	0	0	10,259,396
Bonneville	4,506,833	3,087,181	4,916,333	2,703,983	20,000	14,000	5,805,164
Jefferson	4,218,633	2,889,764	4,080,000	2,244,000	0	0	5,133,764
Madison	3,397,450	2,327,256	3,654,333	2,009,883	0	0	4,337,136
Fremont	2,591,417	1,775,120	4,514,167	2,482,792	0	0	4,257,912
Caribou	1,865,933	1,278,164	4,686,333	2,577,483	0	0	3,855,647
Teton	355,983	243,849	2,677,000	1,472,350	0	0	1,716,199
Bannock	1,860,583	1,274,500	488,667	268,767	0	0	1,543,267
<b>Total</b>	<b>32,113,882</b>	<b>21,998,013</b>	<b>27,084,500</b>	<b>14,896,475</b>	<b>20,000</b>	<b>14,000</b>	<b>36,908,485</b>

Note: Ethanol production is based on 25% of the grain production and typical industry ethanol yields

### South Central Ethanol Production

The South Central Ethanol feedstock area includes the nine counties shown in Table 16. Wheat is the predominant ethanol feedstock in the area with approximately 32.2 million bushels per year. Barley production averaged 15.9 million bushels per year and corn production in the area averaged about 2.6 million bushels annually from 1996 through 2001. Using 25% of the average wheat, barley and corn crop results in about 32 million gallons of denatured ethanol potential in the South Central feedstock area.

**Table 16 – Ethanol potential for the South Central Ethanol plant**

County	Wheat Production (bushels)	Wheat Ethanol (gallons)	Barley Production (bushels)	Barley Ethanol (gallons)	Corn Production (bushels)	Corn Ethanol (gallons)	Total Ethanol Potential (gallons)
Cassia	9,232,633	6,324,354	2,983,067	1,640,687	179,000	125,300	8,090,341
Twin Falls	4,648,917	3,184,508	3,608,667	1,984,767	918,000	642,600	5,811,875
Power	7,240,067	4,959,446	376,167	206,892	388,000	271,600	5,437,938
Minidoka	4,759,867	3,260,509	3,814,683	2,098,076	0	0	5,358,585
Jerome	2,575,183	1,764,001	1,599,833	879,908	402,000	281,400	2,925,309
Lincoln	1,261,600	864,196	832,167	457,692	86,000	60,200	1,382,088

County	Wheat Production (bushels)	Wheat Ethanol (gallons)	Barley Production (bushels)	Barley Ethanol (gallons)	Corn Production (bushels)	Corn Ethanol (gallons)	Total Ethanol Potential (gallons)
Gooding	1,058,900	725,347	331,467	182,307	661,000	462,700	1,370,354
Oneida	1,324,950	907,591	655,000	360,250	0	0	1,267,841
Blaine	157,583	107,945	1,696,783	933,231	0	0	1,041,176
<b>Total</b>	<b>32,259,700</b>	<b>22,097,897</b>	<b>15,897,834</b>	<b>8,743,810</b>	<b>2,634,000</b>	<b>1,843,800</b>	<b>32,685,507</b>

### Southwest Ethanol Production

The Southwest Ethanol feedstock area includes the six counties shown in Table 17. Wheat is the predominant ethanol feedstock in the area with approximately 9.6 million bushels per year. Barley production averaged 2.0 million bushels per year and corn production in the area averaged about 3.9 million bushels annually from 1996 through 2001. Using 25% of the average wheat and corn crop results in 10 million gallons of denatured ethanol potential in the Southwest feedstock area.

Table 17 – Ethanol potential for the Southwest Ethanol plant

County	Wheat Production (bushels)	Wheat Ethanol (gallons)	Barley Production (bushels)	Barley Ethanol (gallons)	Corn Production (bushels)	Corn Ethanol (gallons)	Total Ethanol Potential (gallons)
Canyon	4,524,983	3,099,614	775,167	426,342	1,982,000	1,387,400	4,913,356
Elmore	1,651,883	1,131,540	296,000	162,800	250,000	175,000	1,469,340
Owyhee	922,750	632,084	363,833	200,108	771,000	539,700	1,371,892
Ada	1,127,267	772,178	260,400	143,220	213,000	149,100	1,064,498
Payette	830,350	568,790	101,750	55,963	398,000	278,600	903,353
Gem	585,683	401,193	208,683	114,776	290,000	203,000	718,969
<b>Total</b>	<b>9,642,916</b>	<b>6,605,399</b>	<b>2,005,833</b>	<b>1,103,209</b>	<b>3,904,000</b>	<b>2,732,800</b>	<b>10,441,408</b>

### Panhandle Ethanol Production

The Panhandle feedstock area includes the six counties shown in Table 18. Wheat is the predominant ethanol feedstock in the area with approximately 24.7 million bushels produced each year from 1996 through 2001. Barley production averaged 5.4 million bushels per year. There is no corn produced in the Panhandle feedstock area. Using 25% of the average wheat and barley crop results in 20 million gallons of denatured ethanol potential in the Panhandle feedstock area.

Table 18 – Ethanol potential for the Panhandle Ethanol plant

County	Wheat Production (bushels)	Wheat Ethanol (gallons)	Barley Production (bushels)	Barley Ethanol (gallons)	Corn Production (bushels)	Corn Ethanol (gallons)	Total Ethanol Potential (gallons)
Nez Perce	7,038,800	4,821,578	1,237,333	680,533	0	0	5,502,111
Latah	6,971,550	4,775,512	1,076,500	592,075	0	0	5,367,587
Lewis	4,327,817	2,964,554	1,230,333	676,683	0	0	3,641,237

<b>County</b>	<b>Wheat Production (bushels)</b>	<b>Wheat Ethanol (gallons)</b>	<b>Barley Production (bushels)</b>	<b>Barley Ethanol (gallons)</b>	<b>Corn Production (bushels)</b>	<b>Corn Ethanol (gallons)</b>	<b>Total Ethanol Potential (gallons)</b>
Idaho	3,919,717	2,685,006	1,334,500	733,975	0	0	3,418,981
Benewah	1,992,417	1,364,805	262,333	144,283	0	0	1,509,088
Clearwater	423,900	290,372	245,833	135,208	0	0	425,580
<b>Total</b>	<b>24,674,201</b>	<b>16,901,827</b>	<b>5,386,832</b>	<b>2,962,757</b>	<b>0</b>	<b>0</b>	<b>19,864,584</b>

## V. ETHANOL CAPITAL AND OPERATING COSTS

Capital and operating costs will be estimated for dry mill ethanol plants with the capacities determined in the previous section. Table 19 summarizes the feedstock requirement and ethanol capacities for the four hypothetical ethanol plants identified in the previous section of this report:

**Table 19 – Hypothetical Idaho ethanol production plants**

<b>Location</b>	<b>Wheat Feedstock (bushels/year)</b>	<b>Barley Feedstock (bushels/year)</b>	<b>Corn Feedstock (bushels/year)</b>	<b>Nameplate Capacity (gallons)</b>
<b>Southeast</b>	8,028,471	6,771,125	5,000	37,000,000
<b>South Central</b>	8,064,925	3,974,459	658,500	32,000,000
<b>Southwest</b>	2,410,729	501,458	976,000	10,000,000
<b>Panhandle</b>	6,168,550	1,346,708	0	20,000,000

The estimated total project capital investment is shown in Table 20 for each of the hypothetical ethanol plants. The costs shown are for typical dry mill ethanol plants. Actual costs for ethanol plants in Idaho may be different than the costs shown due to site conditions and other design issues.

Capital cost estimates vary from about \$23 million for the 10 million gallon per year Southwest ethanol plant to \$51 million for the 37 million gallon per year Southeast plant. The capital costs include both the hard costs to design, purchase and install the ethanol plant and the soft costs, which include land, site development, utilities, financing costs, startup costs and beginning inventories.

Operating cost estimates are shown in Table 21. Operating costs include grain feedstocks, chemicals, natural gas, electricity, makeup water, production labor, administrative and operating expenses and financing costs. Total annual operating costs vary from approximately \$18 million for the Southwest plant to \$61 million for the Southeast plant.

**Table 20 – Capital cost estimates for hypothetical ethanol plants in Idaho**

**Idaho Economic Impact Study**

<b>Project Location</b>	<b>Southeast</b>	<b>South Central</b>	<b>Southwest</b>	<b>Panhandle</b>
<b>Plant Design Capacity (gallon/year)</b>	<b>37,000,000</b>	<b>32,000,000</b>	<b>10,000,000</b>	<b>20,000,000</b>
<b>Capital Investment Hard Cost Allocation</b>				
<b>Ethanol Equipment Calculations</b>				
Major Equipment and Field Tanks	\$17,016,045	\$15,371,718	\$7,269,884	\$11,268,174
Equipment Freight and Handling	\$425,401	\$384,293	\$181,747	\$281,704
Instrumentation and Controls	\$1,148,583	\$1,037,591	\$490,717	\$760,602
Electrical	\$3,275,589	\$2,959,056	\$1,399,453	\$2,169,124
Mechanical	\$4,849,573	\$4,380,940	\$2,071,917	\$3,211,430
Steel Structures	\$1,191,123	\$1,076,020	\$508,892	\$788,772
Concrete	\$2,212,086	\$1,998,323	\$945,085	\$1,464,863
Buildings	\$1,446,364	\$1,306,596	\$617,940	\$957,795
Civil/Site	\$1,871,765	\$1,690,889	\$799,687	\$1,239,499
Equipment Rental/Consumables	\$553,021	\$499,581	\$236,271	\$366,216
<b>Subtotal Construction</b>	<b>\$33,989,550</b>	<b>\$30,705,006</b>	<b>\$14,521,594</b>	<b>\$22,508,178</b>
Construction Contingency	\$2,127,006	\$1,921,465	\$908,736	\$1,408,522
<b>Total Construction Cost</b>	<b>\$36,116,555</b>	<b>\$32,626,471</b>	<b>\$15,430,329</b>	<b>\$23,916,700</b>
Process Licensing Fees	\$510,481	\$461,152	\$218,097	\$338,045
Detailed Engineering	\$2,722,567	\$2,459,475	\$1,163,181	\$1,802,908
Construction Management	\$2,127,006	\$1,921,465	\$908,736	\$1,408,522
Engineering Fees and Field Expenses	\$1,063,503	\$960,732	\$454,368	\$704,261
<b>Subtotal Project Services</b>	<b>\$6,423,557</b>	<b>\$5,802,823</b>	<b>\$2,744,381</b>	<b>\$4,253,736</b>
<b>Total Installed Equipment Cost</b>	<b>\$42,540,112</b>	<b>\$38,429,294</b>	<b>\$18,174,711</b>	<b>\$28,170,436</b>
<b>Capital Investment Soft Cost Allocation</b>				
Financing and Development Cost	\$1,724,388	\$1,557,753	\$966,948	\$1,227,891
Owner's Project Administration Expenses	\$2,947,398	\$2,662,579	\$1,652,749	\$2,098,765
Owner Supplied Construction and Assets	\$1,389,103	\$1,254,869	\$778,938	\$989,144
Startup Operations - Capitalized Expenses	\$1,305,869	\$1,179,678	\$732,264	\$929,875
Beginning Inventories	\$856,000	\$927,000	\$339,000	\$662,000
<b>Total Capital Investment Soft Cost</b>	<b>\$8,222,758</b>	<b>\$7,581,879</b>	<b>\$4,469,899</b>	<b>\$5,907,676</b>
<b>Capital Investment Summary</b>				
Total Installed Equipment Cost	\$42,540,112	\$38,429,294	\$18,174,711	\$28,170,436
Total Project Soft Costs	\$8,222,758	\$7,581,879	\$4,469,899	\$5,907,676
<b>Total Capital Investment</b>	<b>\$50,762,870</b>	<b>\$46,011,173</b>	<b>\$22,644,610</b>	<b>\$34,078,112</b>
<b>Capital Investment per Gallon</b>	<b>\$1.37</b>	<b>\$1.44</b>	<b>\$2.26</b>	<b>\$1.70</b>

**Table 21 – Estimated operating costs and direct jobs for proposed ethanol plants**

<b>Plant Location</b>	<b>Southeast</b>	<b>South Central</b>	<b>Southwest</b>	<b>Panhandle</b>
<b>Production &amp; Operating Expenses</b>				
Feedstocks	\$41,497,405	\$35,511,368	\$10,797,193	\$22,230,765
Chemicals, Enzymes & Yeast	\$2,847,238	\$2,462,476	\$769,524	\$1,539,048
Natural Gas	\$5,097,111	\$4,531,781	\$1,451,884	\$2,923,977
Electricity	\$1,543,527	\$1,372,331	\$439,665	\$885,450
Denaturants	\$1,258,000	\$1,088,000	\$340,000	\$680,000
Fresh Water	\$437,280	\$376,621	\$115,671	\$236,720
Effluent Treatment & Disposal	\$109,320	\$94,155	\$28,918	\$59,180
Direct Labor & Benefits	\$1,185,874	\$1,083,476	\$644,828	\$868,995
<b>Total Production Costs</b>	<b>\$53,975,754</b>	<b>\$46,520,208</b>	<b>\$14,587,682</b>	<b>\$29,424,134</b>
<b>Administrative &amp; Operating Expenses</b>	<b>\$2,508,104</b>	<b>\$2,356,931</b>	<b>\$1,543,994</b>	<b>\$1,871,537</b>
Interest - Senior Debt	\$2,385,352	\$2,165,711	\$1,066,107	\$1,617,607
Depreciation & Amortization	\$2,169,635	\$1,970,635	\$982,808	\$1,470,025
<b>Total Annual Operating Costs</b>	<b>\$61,038,845</b>	<b>\$53,013,486</b>	<b>\$18,180,591</b>	<b>\$34,383,302</b>
<b>Direct Jobs</b>	<b>38</b>	<b>36</b>	<b>24</b>	<b>28</b>

## VI. ECONOMIC IMPACTS

Construction and operation of ethanol plants in Idaho will create significant economic activity in local communities where the production facilities are located. The ethanol plant construction and operation will involve expenditures, income, employment and payment of taxes. The expenditures of any business become the income of other businesses or individuals, which in turn is re-spent in the economy to provide income for others. Thus the initial economic activity has a multiplier effect that ripples through the economy. Economic impact analysis is an analytical method that provides a measure of the economic effects of an activity within a specified region.

In this section BBI has estimated the economic impacts of ethanol production from wheat, barley and corn for four ethanol plants as described in the previous section. The final demand impact, household earnings impact and job impacts were estimated by applying the appropriate final demand multipliers calculated by the U.S. Bureau of Economic Analysis for output, earnings, and employment to the estimates of new capital spending and annual operating expenditures associated with the proposed ethanol plants. The resulting economic impacts are reported as estimated changes in the economic base (final demand), income, jobs and taxes resulting from ethanol production in Idaho.

### **Methodology**

The method used in the current study provides specific measures of economic impact in the following categories.

**Total Expenditures** – Total expenditures are the sum of all direct spending made by the proposed ethanol facilities in Idaho. This category includes all direct costs associated with two distinct phases of activity and spending: construction and operation. Construction is a short-term, one-time activity associated with establishing an ethanol production capability. The operations phase is a longer term, ongoing activity associated with ethanol production.

Total expenditures includes salaries and wages paid to direct employees, profits or compensation paid to owners and managers, purchases of equipment, feedstocks and process raw materials, and all contracted services.

Data for total expenditures come from construction and operating cost estimates developed from project-specific data where possible, as well as from industry averages and existing data on comparable facilities.

**Direct Income** – Direct income is the sum of money paid directly by the facility or project to its direct employees in the state. Direct income also includes profits or dividends paid to owners in the state. It does not include payments to contractors.

**Direct Employment** – Direct employment is the number of persons employed directly by the proposed plants in the state, including owners and managers. This information is estimated from industry sources.

**Indirect Income** – Indirect income, as used in this analysis, is the sum of the indirect and induced income. It is composed of the sum of the expenditures made by the companies that supply the planned facility (indirect income), plus the expenditures made by employees of the facility and the expenditures made by employees of the suppliers (induced income). These expenditures typically include such items as spare parts, supplies, fuel, utilities, trucking, financial services, and the retail or other personal expenditures of employees. Estimates of indirect income are obtained by taking the plant's expenditure for supplies, equipment, and services and applying multipliers to estimate the amount of indirect and induced income from each class of expenditure.

**Indirect Employment** – Indirect employment is the number of persons employed as a result of the indirect income generated by the facility in the area of interest. The indirect employment is estimated by applying the appropriate indirect employment multiplier to the total amount of indirect income associated with the plant.

**State Tax Revenue** – The amount of corporate tax revenue paid to the state by an ethanol plant will be dependent on the profitability of the plant as well as its parent company. Since it is impossible to predict the future profitability and financial performance of a given facility, or the actual amount of facility-specific tax payments, in the present study taxes paid to the state are assumed to be a percentage of net income for the facility, and all directly and indirectly related activities are the same as the state average.

Any incentives provided by the state are included in the analysis of state tax revenues. Incentive payments, producer credits, tax exemptions and credits, and subsidies are factored into the analysis, to estimate the impact of the proposed facilities on state tax revenues. In the case where incentive payments and tax credits are offered by the state, the return on incentives to the state can also be calculated.

## **Analysis Inputs**

The inputs required for the economic analysis are the ethanol project direct impacts divided into construction phase impacts and operations phase impacts. This distinction is important because the construction phase impacts are a one-time event while the operations phase impacts are ongoing impacts. Construction phase impacts for the ethanol plants are assumed to occur over a 15-month construction and startup period, while the operations phase will normally last many years and are characterized by expressing the impacts on an annual basis. This distinction is important because the construction and operations impacts are usually very different in character as well as magnitude. Construction may bring temporary workers into the area that take up

temporary residences near the site and therefore have a different impact than the permanent workers and contractors of the operations phase.

The following tables list the analysis inputs for the four hypothetical plants based on the estimated cost to construct and operate the proposed ethanol plants at the Idaho sites. The construction and operating costs in the table are discussed in the cost estimate section of this report.

Operating expenditures include all payments made directly by the ethanol plant owner. These payments include all production and administrative costs projected for the first full year of commercial operation for the project.

**Table 22 – Economic impact analysis inputs for Idaho ethanol plants**

<b>Construction Phase Impacts</b>	<b>Southeast</b>	<b>South Central</b>	<b>Southwest</b>	<b>Panhandle</b>
Ethanol Plant Capital Cost (millions)	\$50.8	\$46.0	\$22.6	\$34.1

<b>Operations Phase Impacts</b>	<b>Southeast</b>	<b>South Central</b>	<b>Southwest</b>	<b>Panhandle</b>
Operating Expenditures (millions)	\$61.0	\$53.0	\$18.2	\$34.4
Ethanol Plant Direct Jobs	38	36	24	28

Tax rates used in the economic impact analysis are 7.8% for individual or personal income taxes in Idaho and a combined state and federal corporate tax rate of 41% (source Tax Foundation, Washington, DC; <http://taxfoundation.org/home.html>).

### **Economic Impacts**

The results of the economic impact analysis for the Idaho ethanol plants are presented in Table 23 below. There are three primary measures of economic impact presented, which should be considered separately. These are income, employment and taxes. Income and employment include both indirect and induced impacts. Taxes are estimated for both local and state level based on tax rates in Idaho. The results are separated into the construction phase and operations phase impacts. Construction phase and operations phase impacts should be considered separately and should not be added together. Although the impacts are expressed in the same manner, they are not directly comparable.

The construction spending associated with building the four ethanol plants in Idaho will add approximately \$373 million to the final demand in the local economy and generate \$121 million in new household income and provide for 3,777 direct and indirect jobs during construction of the four hypothetical ethanol plants presented in this report.

During the operations phase, the four ethanol plants will create nearly 1,900 new jobs and add approximately \$327 million to the final demand in the local economy. New

household income will be approximately \$58 million annually. Annual state tax revenue is estimated to be \$4.54 million on the new earnings.

**Table 23 – Economic impacts of ethanol production in Idaho**

<b>Construction Phase Impacts</b>	<b>Southeast</b>	<b>South Central</b>	<b>Southwest</b>	<b>Panhandle</b>
Ethanol Plant Capital Cost (millions)	\$50.8	\$46.0	\$22.6	\$34.1
Final Demand Impact (millions)	\$123.2	\$111.7	\$54.9	\$82.7
Personal Earnings Impact (millions)	\$40.0	\$36.2	\$17.8	\$26.8
Employment Impacts (direct and indirect jobs)	1,249	1,132	557	839

<b>Operations Phase Impacts</b>	<b>Southeast</b>	<b>South Central</b>	<b>Southwest</b>	<b>Panhandle</b>
Local Spending (millions)	\$61.0	\$53.0	\$18.2	\$34.4
Final Demand Impact (millions)	\$119.8	\$104.0	\$35.7	\$67.5
Personal Earnings Impact (millions)	\$21.3	\$18.5	\$6.3	\$12.0
Employment Impacts (direct jobs)	38	36	24	28
Employment Impacts (indirect jobs)	645	560	192	363
Total Jobs (direct + indirect)	683	596	216	391

### **Corporate and Personal Income Tax Revenues**

The operation of ethanol facilities in Idaho will potentially generate corporate as well as personal income tax revenues for both the federal and state governments. The projected tax revenues are shown in Table 24. The tax revenues shown are estimates only and will depend upon the profitability and ownership structure of each ethanol plant. The “Average Ethanol Plant Pre-Tax Income” shown in the table is based on ethanol feasibility studies conducted by BBI in Idaho and throughout the Midwest and is subject to change.

The state producer payments shown in Table 24 are to demonstrate the potential return to the State only -- the payments are hypothetical and are currently not provided by Idaho statute. We have assumed that the payments are capped at \$2 million per year per ethanol facility. For the example in Table 24, the total annual Producer Payments of \$7.9 million is more than offset by \$11.3 million in increased State and Federal tax revenue.

**Table 24 – Estimated tax impacts of ethanol production in Idaho**

<b>Tax Impacts (millions)</b>	<b>Southeast</b>	<b>South Central</b>	<b>Southwest</b>	<b>Panhandle</b>
Personal Earnings Impact (note 1)	\$21.3	\$18.5	\$6.3	\$12.0
Idaho Income Tax on Personal Earnings (note 2)	\$1.7	\$1.4	\$0.5	\$0.9
Average Ethanol Plant Pre-Tax Income (note 3)	\$6.1	\$4.9	\$2.0	\$3.7
State & Federal Corporate Income Tax Revenue (note 4)	\$2.5	\$2.0	\$0.8	\$1.5
Total Tax Revenue (millions)	\$4.1	\$3.4	\$1.3	\$2.5
State Producer Payment (note 5)	\$2.0	\$2.0	\$1.9	\$2.0
Annual Return to State (millions)	\$2.1	\$1.4	(\$0.6)	\$0.5

Notes:

1. The Personal Earnings Impact includes direct and indirect personal earnings resulting from the operation of four ethanol plants in Idaho.
2. Idaho personal income tax rate is 7.8%.
3. Average Ethanol Plant Pre-Tax Income estimated by BBI based on ethanol feasibility studies conducted in Idaho and throughout the Midwest.
4. A combined state and federal corporate income tax rate of 41% has been assumed.
5. State Producer Payments are hypothetical and are assumed to be capped at \$2 million per year per Idaho ethanol facility. Producer Payments are currently not provided in Idaho.

**Value Added to Wheat, Barley and Corn**

Value added to the wheat, barley and corn feedstocks at the local level is another reason to produce ethanol and high protein co-products in Idaho. There are over 105 million bushels of wheat, 55 million bushels of barley and nearly 7 million bushels of corn produced in Idaho each year. Much of these grains are exported out of the state. For example, about 70% of the wheat crop is exported from Idaho every year. The grains utilized and estimated value of the distillers grains (DG) for each potential ethanol plant is shown in the table below.

The grain assumed to be processed in each ethanol facility and the estimated value of the distillers grains have been estimated by BBI based on market conditions and previous ethanol feasibility studies conducted in Idaho. The distillers grains are referred to as DG for this study and not distillers wet grain (DWG) or distiller dried grain and solubles (DDGS) since it is not known if the product will be sold wet or dry. The ability to sell wet DG is an example of what could be a site-specific, or project-specific, advantage.

**Table 25 – Grain utilized and value of distillers grain (DG) in proposed ethanol plants**

<b>Location</b>	<b>Nameplate Capacity (gallons)</b>	<b>Wheat (bu/year)</b>	<b>Barley (bu/year)</b>	<b>Corn (bu/year)</b>	<b>DG Value (million \$)</b>
<b>Southeast</b>	37,000,000	8,028,471	6,771,125	5,000	\$16.73
<b>South Central</b>	32,000,000	8,064,925	3,974,459	658,500	\$14.02
<b>Southwest</b>	10,000,000	2,410,729	501,458	976,000	\$4.20
<b>Panhandle</b>	20,000,000	6,168,550	1,346,708	0	\$8.53
<b>Total</b>	99,000,000	24,672,675	12,593,750	1,639,500	\$43.48

Table 26 illustrates the economic impact on the value added to the Idaho grains processed by the ethanol facilities. It is presented on a statewide basis since the individual details of transportation costs and other specific plant location advantages are not known at this time. The ethanol price and grain cost are based on USDA data as well as information from the BBI database. The value added to grain benefiting the State of Idaho is approximately \$0.71 per bushel, or \$27.6 million annually.

**Table 26 – Value added to Idaho grains by ethanol production**

<b>Product</b>	<b>Annual Quantity</b>	<b>Price</b>	<b>Revenue (Cost)</b>	<b>Revenue per bushel</b>
Ethanol	99 million gallons	\$1.30/gal	\$128,700,000	\$3.31
Distillers Grain	362,300 tons	\$120/ton	\$43,476,000	\$1.12
Grain	38,906,000 bushels	\$2.83/bu	(\$110,103,980)	(\$2.83)
Production Costs			(\$34,471,049)	(\$0.89)
<b>Value Added</b>			<b>\$27,600,971</b>	<b>\$0.71</b>

Notes:

1. It is assumed that the DG will be sold in the State of Idaho to local dairies or other users.
2. The sale of carbon dioxide (CO<sub>2</sub>) has not been estimated for this analysis in order to be conservative and not draw any conclusions as to the local markets for CO<sub>2</sub>.
3. Production costs were estimated by BBI based on previous ethanol feasibility studies in Idaho.

## **VII. CONCLUSIONS**

Ethanol production holds the potential to bring significant economic development to Idaho while adding value to local crops that are largely exported out of the state. The analysis of the available feedstocks presented herein, indicate that Idaho wheat, barley and corn could support approximately 100 million gallons of annual ethanol production. Four ethanol plants with this combined capacity would create nearly 3,800 jobs during construction and about 1,900 permanent jobs during commercial operation of the facilities. Total resulting state and federal tax revenue is estimated to be \$11.3 million annually.