Farm Business Management Report

2011 Economic Contribution Analysis of Washington Dairy Farms and Dairy Processing: An Input-Output Analysis

May 2013

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Executive Summary and Project Overview

Historically, milk has been Washington's second leading agricultural commodity in terms of value of production following apples. Further when you consider livestock sales from cull cows and calves in addition to milk's value of production, dairy production is a vitally important agriculture commodity in Washington's economy. The majority, about 90% of the milk produced in Washington is also processed in Washington. Processing milk creates additional contributions to employment and the state economy. Cash receipts generated by milk production and livestock sales are important measures of the dairy sector direct economic contribution on Washington State. In addition to the direct effect, dairy production and processing indirectly contribute to the regional economy through purchases of inputs such as labor, services, equipment and feed. More generally, Washington's economy is affected by income and employment growth within the dairy industry and its supporting businesses. Through this cycling of dollars and industry linkages, economic contributions in the dairy sector have an effect on the general economy in Washington that is considerably greater than its direct effects alone.

The purpose of this report is to describe the economic state, conditions and trends for Washington State dairy farm production and the dairy processing sector to estimate the dairy sector state level economic contribution using 2011 production data. Measures of economic contribution are estimated using an input-output (I/O) analysis, which explicitly recognizes interrelationships between industries. It measures how an economic sector affects other sectors within an economy in terms of output, income, and employment.

The following table presents the estimated dairy farming and manufacturing economic contribution results. The dairy cull cow economic contribution is estimated at the processing level. The dairy farming total economic output is about $2.364 Billion. The dairy product manufacturing total economic output is about $2.576 Billion. The dairy cull cow economic output is $0.261 Billion. The combined total economic contribution of Washington's dairy industry is about $5.201 Billion. The economic multipliers of dairy farming, processing and cull cows are about 1.854, 1.290 and 1.949 respectively.

The estimated number of dairy farming direct jobs is 6,184 jobs which is a full time equivalency job rate of 5,256 jobs. The total number of jobs due to dairy farming is 12,159 jobs. For dairy manufacturing the direct employment is 1,012 jobs and the total number of jobs due to dairy manufacturing is 4,497. The total combined number of total jobs is 18,066.

Economic Contributions of the Washington Dairy Industry

Dairy Farming				
Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	6,184	71,612,578	388,676,231	1,274,640,000
Indirect Effect	4,221	186,121,549	358,466,996	852,922,255
Induced Effect	1,754	79,625,661	147,700,036	236,010,720
Total Effect	12,159	337,359,789	894,843,263	2,363,572,974

Dairy Product Manufacturers				
Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	1,012	75,718,896	134,805,754	1,996,401,877
Indirect Effect	2,047	135,549,421	214,632,335	386,212,380
Induced Effect	1,438	65,300,680	121,115,662	193,555,516
Total Effect	4,497	276,568,998	470,553,751	2,576,169,773

Cull Cow via Beef Processing Industry				
Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	304	14,624,496	16,794,906	134,000,000
Indirect Effect	861	21,219,219	38,223,758	94,305,881
Induced Effect	244	11,077,288	20,544,776	32,834,034
Total Effect	1,409	46,921,003	75,563,440	261,139,915

Combined Dairy Farming, Product Manufacturers and Cull Cow Processing				
Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	7,500	161,955,970	540,276,891	3,405,041,877
Indirect Effect	7,129	342,890,190	611,323,090	1,333,440,516
Induced Effect	3,437	156,003,629	289,360,474	462,400,270
Total Effect	18,066	660,849,789	1,440,960,455	5,200,882,662

The following table presents the comparative Washington dairy farm economic contribution from the previous 2006 study (Neibergs and Holland, 2007) to the current study which estimates Washington's 2011 dairy farm economic contributions. The comparison can only compare the dairy farm level because the 2006 study did not include the dairy processing sector. In 2006 the dairy cull cow impact is impeded in the contribution analysis and in 2011 cull cow economic contribution is analyzed at the processing level.

2006 to 2011 Washington Dairy Farm Economic Contribution Comparative Results

	2006	2011	Change
Dairy Cows	237,000	260,000	23,000
Milk Production (lbs/cow)	23,055	23,727	672
Milk Price ($/cwt)	$12.60	$20.70	$8.10
Cull Cow Price ($/cwt)	$47.37	$69.70	$22.33
Economic Contribution	$	$	$
Direct Effect	784,000,000	1,274,640,000	490,640,000
Total Economic Effect	1,470,791,430	2,363,572,974	892,781,544
Employment (jobs)	Jobs	Jobs	Jobs
Direct Effect	6,168	6,184	16
Total Effect	12,653	12,159	-494

Washington's dairy farm industry has grown appreciably between 2006 in terms of the number of dairy cows, an increase of 23,000 head and prices. The 2011 direct economic contribution is about $1.275 Billion dollars and the total economic contribution is about $2.364 Billion dollars to the economy based on 2011 costs of production and milk prices. The increase in economic impact between 2006 and 2011 is about $491 million dollars. This is an economic contribution growth increase of about 51 percent between 2006 and 2011 due to the aforementioned increase in state herd size and increases in milk price and cull cow price. It is important to note that the contributions are sensitive to prices. Mmilk price and dairy product prices have a direct effect on the direct economic effect and through economic linkages the indirect and induced economic effects. The increase in dairy economic contribution does not necessarily mean that dairy production is more profitable, but that dairy revenue increased due to increased production and price. Due to the increase in feed, hay, labor and other production costs dairy profitability continues to be challenged, but dairy producers pass on increased revenues through the economy thus increasing its economic contribution to Washington's economy. The increase in the dairy farm sector made a significant contribution to the state in a comparatively slow growth economy. Over the same period from 2006 to 2011, state GDP grew from $300.2 billion dollars to $355.1 billion dollars which is an 18.3 percent increase.

Washington dairies create substantial employment throughout the State. Washington's dairy farm 2011 direct employment effect is 6,184 jobs and its total jobs estimate is 11,822. Although Washington herd size increased the number of dairy operations is in a declining trend. In an effort to improve profitability have improved labor efficiency so the number of direct jobs showed only an increase of 16 jobs. The total number of jobs declined slightly as predicted by the IMPLAN modeling system of economic linkages.

This project was undertaken with the financial support of the Washington Dairy Commission and the Washington Dairy Federation. Research was conducted through the WSU Extension and the School of Economic Sciences. A survey entitled "Washington Dairy Products Commission Washington Dairy Federation and WSU Extension, 2011 Dairy Economic Impact Survey was conducted from July 2012 to October 2012 to obtain economic data on dairy farm production, revenue, operating costs and employment.

I. An Economic Overview of the Washington Dairy Farm Sector

Washington has long been a national leader in terms of milk yield per cow. Table 1 shows a comparative table of state herd production statistics. The table is ranked by herd size and Washington ranks 11th in herd size. This is the same comparative herd size ranking as found in the 2006 economic contribution study. Washington's average annual milk yield per cow is 23,510 and 23,727 for 2010 and 2011. Washington has the most productive cows as identified in the table. Historically, Washington has been number one or two in terms of milk yield per cow and shows Washington's long standing comparative advantage in milk production yield.

Table 1. Milk Cows and Production Leading States 2010 and 2011

State	Rank by Milk Cows	Milk Cows (1,000 head) 2010	Milk Cows (1,000 head) 2011	Milk per cow (pounds) 2010	Milk per cow (pounds) 2011	Milk Production (million pounds) 2010	Milk Production (million pounds) 2011
California	1	1754	1769	23,025	23,438	40,386	41,462
Wisconsin	2	1262	1265	20,630	20,646	26,035	26,117
New York	3	611	610	20,807	21,026	12,713	12,826
Idaho	4	564	578	22,658	22,934	12,779	13,256
Pennsylvania	5	541	541	19,847	19,601	10,737	10,604
Minnesota	6	470	468	19,366	18,966	9,102	8,876
Texas	7	413	431	21,375	22,232	8,828	9,582
Michigan	8	358	366	23,277	23,164	8,333	8,478
New Mexico	9	321	329	24,551	24,854	7,881	8,177
Ohio	10	271	268	19,446	19,187	5,270	5,142
Washington	11	251	260	23,510	23,727	5,901	6,169
United States		9119	9194	21,148	21,345	192,849	196,246

Source: http://usda01.library.cornell.edu/usda/nass/MilkProd/2010s/2012/MilkProd-02-17-2012.pdf

Table 2. Washington Dairy Herd Demographics and Production Trends

Year	Milk Cows on Farms 1,000 head	Milk/Cow Lbs	Milk Fat/Cow Lbs	Total Milk Production Million Lbs	Milk Fat Production Million Lbs	Milk Price $/cwt	Milk Fat Price $/lb	Milk Cash Receipts 1000's $
1980	201	14,637	536	2,942	108	$13.01	$3.55	$378,095
1981	205	14,717	537	3,017	110	$13.81	$3.78	$413,822
1982	212	15,198	561	3,222	119	$13.66	$3.70	$436,440
1983	216	16,120	588	3,482	127	$13.67	$3.75	$472,327
1984	214	16,206	593	3,468	127	$13.46	$3.68	$463,211
1985	223	16,816	627	3,750	140	$12.76	$3.42	$476,047
1986	214	17,579	650	3,762	139	$12.47	$3.37	$465,864
1987	216	17,421	643	3,763	139	$12.62	$3.42	$472,340
1988	221	17,946	668	3,966	148	$12.50	$3.36	$492,850
1989	225	18,209	676	4,097	152	$13.65	$3.68	$556,344
1990	237	18,532	680	4,392	161	$13.73	$3.74	$599,294
1991	237	18,814	698	4,459	165	$12.57	$3.39	$557,943
1992	249	19,422	719	4,836	179	$13.40	$3.62	$645,710
1993	257	19,377	711	4,980	183	$12.83	$3.49	$635,005
1994	261	19,935	724	5,203	189	$13.09	$3.61	$677,191
1995	264	20,091	729	5,304	193	$12.98	$3.57	$684,172
1996	264	20,541	728	5,279	192	$15.01	$4.12	$788,075
1997	253	20,968	763	5,305	193	$13.81	$3.79	$728,143
1998	248	21,476	786	5,326	195	$15.90	$4.34	$842,541
1999	247	22,409	818	5,535	202	$14.90	$4.08	$820,245
2000	247	22,644	827	5,593	204	$12.80	$3.51	$711,168
2001	247	22,324	817	5,514	202	$15.00	$4.10	$822,000
2002	247	22,753	835	5,620	206	$12.00	$3.27	$671,040
2003	245	22,780	834	5,581	204	$12.10	$3.31	$671,792
2004	237	22,852	841	5,416	199	$15.90	$4.32	$857,010
2005	241	23,270	854	5,608	206	$14.90	$4.06	$832,165
2006	237	23,055	853	5,464	202	$12.60	$3.41	$686,196
2007	238	23,239	860	5,531	205	$19.20	$5.19	1,059,264
2008	244	23,344	859	5,696	210	$17.60	$4.78	1,000,032
2009	240	23,171	860	5,561	206	$12.30	$3.32	$681,912
2010	251	23,510	877	5,901	220	$16.10	$4.32	$947,485
2011	260	23,727	895	6,169	233	$20.70	$5.49	$1,274,640

Source: http://www.nass.usda.gov/Statistics_by_State/Washington/Historic_Data/dairy/milkdisp.pdf

Milk production per cow with a few exceptions has been continuously increasing in Table 2 from 1980 to 2011 to 23,727 lbs of milk per cow. Similarly, milk and milk fat production has been increasing in a linear trend. Milk cash receipts or the value of farm production has substantial variation over time due to variability in milk price. The milk price for 2011 was the highest price over the years reported in Table 2 at $20.70 per cwt. Figure 1 shows Washington's historic value of milk production variability on a nominal and deflated basis. The values are deflated using a CPI index, 1982 to 1984 = 100. Figure 1 is striking in that on a nominal basis the value of milk production is increasing with variability between years due to variable milk price, but it is on an increasing trend. The value of milk production reached a record high of $1.272 Billion dollars in 2011. However when the value of production is deflated, Washington's value of production has remained mostly steady since 1980, with only some gain in 2010 and 2011. This can be explained when you look at the nominal milk price in 2010 and 2011.

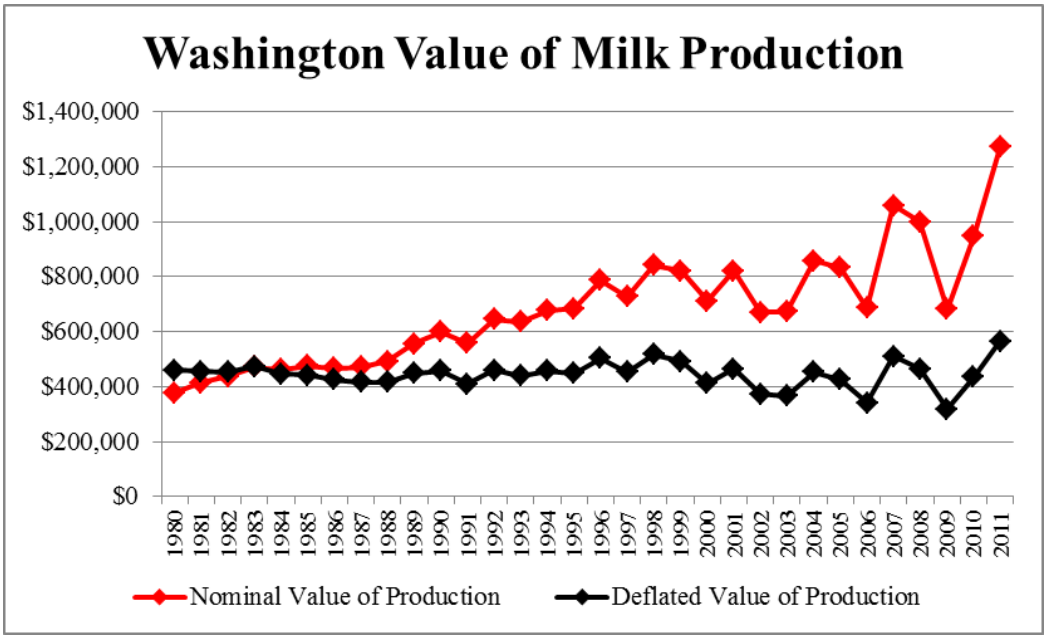

Figure 1. Nominal and Deflated Washington Value of Milk Production.

Figure 2 illustrates Washington's farm milk price variability. Nominal milk price exhibits increasing price variation from about 1998 through the end of the series. Importantly when deflating the milk price using the consumer price index, (1982-84 = 100), the milk price producers receive shows a negative trend.

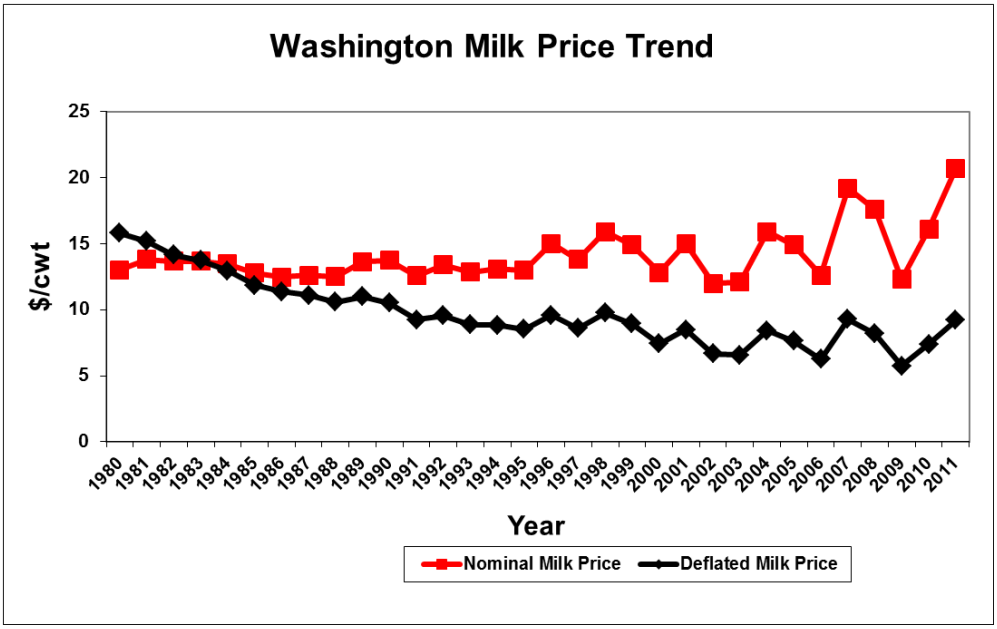

Figure 2. Nominal and Deflated Washington Milk Price.

The lack of growth in milk prices has depressed dairy farm profitability and as a result the number of dairy farms in the state has declined. From 1996 to 2007 (the latest data available) the number of dairy farms has decreased from 1,700 to 820, a decline of about 54 percent. Figure 3 illustrates the declining trend in the number of Washington's dairy operations from 1990 to 2007. In 2007 the USDA changed reporting on this data item from annually to once every five years coinciding with the USDA Agricultural Census. Current data on number of dairy operations is not available at the time of this report. The declining trend in the number of operations has an economic effect as the number of dairy cows per farm increases. This provides dairy operators some economies of size and improved labor efficiency, but that works to decrease overall employment numbers on dairy farms.

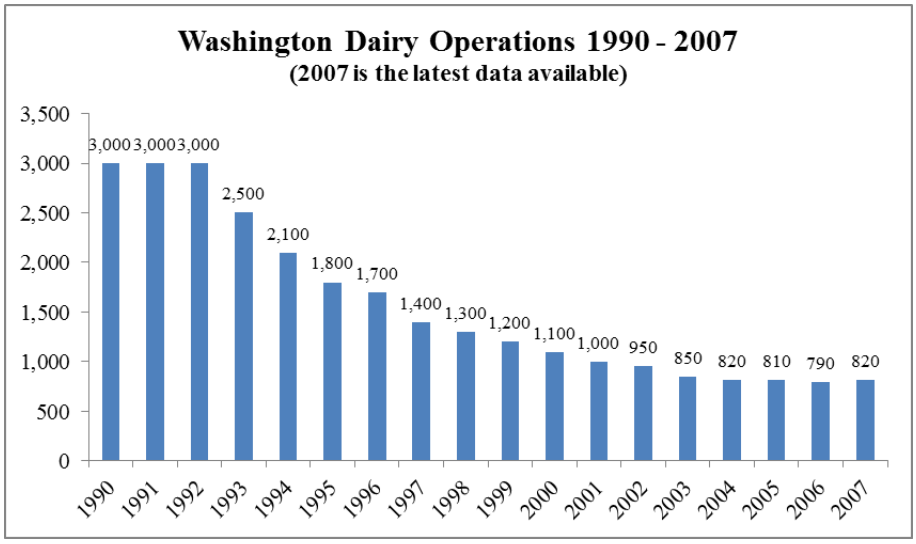

Figure 3. Trend in Washington Dairy Operation Numbers 1990 to 2007.

Washington Leading Dairy Counties

Using an east-west boundary line of the Cascade Mountain range, approximately 55 percent of Washington dairy herd is East of the Cascades leaving 45 percent west of the Cascades Mountain range. This is a shift in geographic production in Washington in comparison to the 2006 report when the proportions were the same but 55 percent of the milk production was west and 45 percent was east of the Cascades. Table 3 shows the eastern counties increasing in herd size with Yakima County increasing the most in cow numbers and Franklin County having the largest percent increase. The east side's dairy production is primarily located in Yakima and Grant Counties. As shown in Table 3 Yakima is the county with the largest number of dairy cows, 93,000 cows and about 37 percent of the State's dairy cow population and Grant county has 10 percent of the State's dairy cows. Whatcom is the leading West side dairy county and has twenty percent of the State's dairy cows. The top 10 counties account for about 90 percent of the State's dairy production.

Table 3. Washington's Top Ten Dairy Counties Change 2006 to 2011.

Rank	County	Milk Cow Number		Percent Change	2011 Percent of State Total
		2006	2011		
1	Yakima	70,500	93,000	32	36
2	Whatcom	52,000	51,000	-2	20
3	Grant	16,500	24,500	48	9
4	Snohomish	16,500	11,000	-33	4
5	Skagit	16,000	14,200	-11	5
6	King	10,500	10,300	-2	4
7	Lewis	9,500	6,300	-34	2
8	Adams	8,400	6,400	-24	3
9	Thurston	6,500	5,300	-18	2
10	Franklin	6,400	12,000	88	5
	Top Ten Total	212,800	234,000	10	90

Source:
http://www.nass.usda.gov/StatisticsbyState/Washington/HistoricData/dairy/mlcopsz.pdf

Pacific Northwest Regional Trends

Washington is seeing increased regional competition in dairy production primarily from Idaho's growing dairy industry, and a continued strong California dairy industry. Idaho is one of the fastest growing dairy states in the nation. Figure 4 illustrates Pacific Northwest dairy cow numbers. Since 1990, Idaho's cow numbers have grown from 179,000 cows to 478,000 in 2006. This represents an average annual growth rate of 6.4 percent in cow numbers for Idaho. Idaho surpassed Washington's cow population in 1997. Idaho's growth in dairy herd size has

introduced increased regional competition in dairy feedstuff markets notably high quality alfalfa hay and has injected tremendous milk production into the regional milk market.

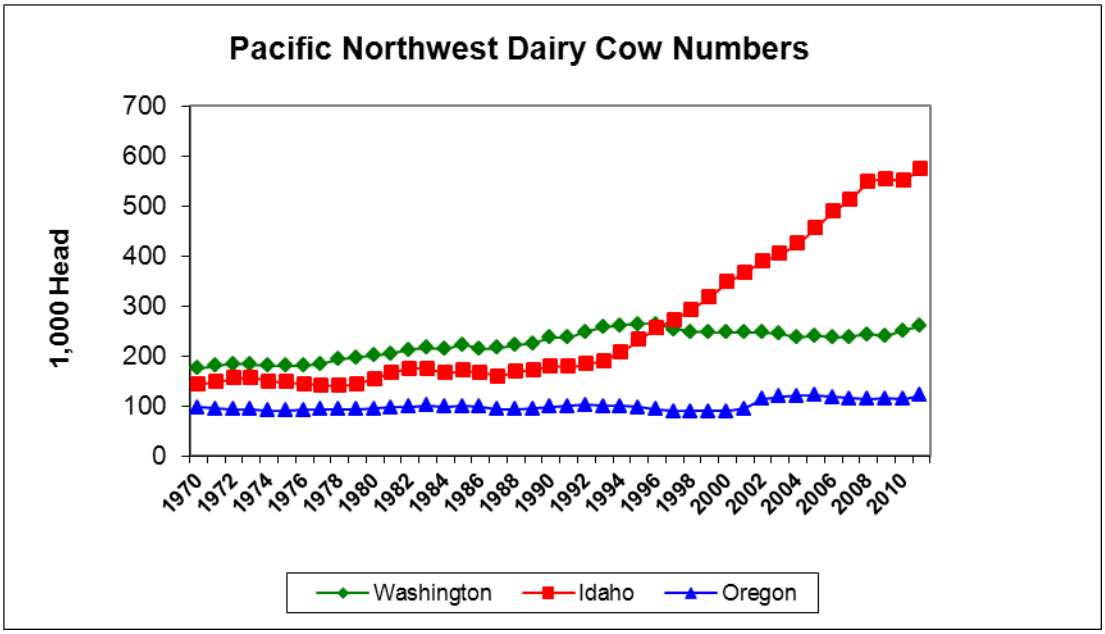

Figure 4. Growth in Pacific Northwest Dairy Cow Numbers.

The Pacific Northwest's comparative national ranking by total milk production is given in Table 4. Washington has fallen slightly in the rankings as New Mexico and Idaho dairy production has been expanding. Washington's national ranking is currently eleventh for total milk production. Table 4 further identifies Idaho's dramatic growth in dairy production as it has increased in state rankings from tenth to fourth over the 1994 to 2011 time periods provided in the table. Oregon has remained the 16th ranked dairy production state, since 2000.

Table 4. Pacific Northwest States Comparative Rank in National Milk Production by Volume of Milk Produced.

	1994	2000	2006	2011
Washington	8	9	10	11
Idaho	10	6	4	4
Oregon	15	16	16	16

Summary of the Economic State of Washington Dairy Farms

Washington's dairy strength is concentrated in its herd of highly productive milking cows and remains a national leader in terms of milk cow yields. This section presented the demographic statistics of Washington dairy cow numbers, production, prices and value of production. Milk prices have increased in 2010 and 2011, and 2001 a record high nominal milk price and had a value of farm production of just over $1.2 Billion dollars. Dairy farmers continue to face economic challenges concerning increasing production costs from feed, labor and employee benefit expenses.

II. 2011 Dairy Economic Contribution Survey Results

A survey was conducted from July 2012 to October 2012 to obtain data needed to estimate the economic impact of Washington's Dairy industry using 2011 costs and returns (see appendix 1). The study's basic framework is built around an economic model to identify dairy farming annual revenues and costs of production. Estimating an industry's economic contribution requires data on income, expenses, sources of inputs purchased, capital improvements, and taxes paid. This research utilizes primary data acquired through the survey instrument in an attempt to improve and calibrate IMPLAN's internal production functions to improve the economic modeling data inputs representing Washington's economic conditions. The survey included questions on revenues received by producers for commodities other than milk, such as the sales of heifers, calves, cull cows, and other revenues received. The expense categories included questions on the actual expenses incurred (operating and capital) and on the percentage purchased locally, regionally and out of state. For capital expenses, producers were asked to provide typical annual expenditures.

Surveys were sent to all 480 Washington Dairy Federation member dairy farm owners. Forty-four surveys were returned and yielded 40 usable surveys representing a usable response rate of about 8 percent. Using the 2011 USDA reported herd size and production as reported in Section I, the survey response represents approximately 17.1 percent of the total state's inventory of dairy cows.

Table 5 presents a demographic summary of the survey respondents' dairy operations. The average number of years the dairy operated at its location was 43 years. On average the farm milked 978 cows and had an average annual milk yield per cow of 22,564 pounds of milk per cow. The average dairy owned 652 acres and 31 percent of the respondents leased an additional 350 acres on average. Most of the leases were for the nutrient management program. Ninety-one percent of the respondents raised crops for their dairy with the majority of raised crop acreage used for corn silage. Only 9 percent of the dairies raised crops for cash sale.

Table 5. Survey Results – Dairy Farm Demographics

Description	n	Average	Standard Deviation
How long had dairy operated at this location (years)	40	43	27
Number of cows milked	40	978	1,573
Annual milk production per cow (lbs)	40	22,564	6,763
Number of acres owned	40	652	743
Number of acres leased	40	350	384
Do you raise crops for feed (yes = 1)	40	0.91	0.29
Do you raise crops not used for feed (yes = 1)	40	0.09	0.29

Table 6 provides summary statistics on the revenue generating activities of the dairy. Clearly milk sales dominate the dairies revenue stream. The average dairy generates about $5.4 million dollars in milk sales. Additional revenues from cull cows, calves and replacement heifers contribute to total dairy revenue.

Table 6. Survey Results - Dairy Farm Sales and Receipts

Description	n	Average $	Standard Deviation $
Milk sales	37	5,389,622	8,193,885
Cull cows	36	254,112	429,288
Calves	33	55,342	175,937
Replacement heifers	11	31,491	66,083
Other dairy income	22	159,981	436,394

The survey results average dairy farm expenses are provided in Table 7. The labor and benefit expenses are separated out from operating and capital expenses. The average annual operating expense per farm was about $4.72 million. The average farm expense for labor was $456,121 and on average paid $73,526 in benefit expense. The survey asked for average over the past five year annual capital expense cost. The average annual capital expense cost was $188,691. The average annual property tax paid per farm was $29,091.

Table 7. Survey Results - Dairy Farm Expenses

Description	N	Average $	Standard Deviation $
Annual labor expense	34	456,121	835,887
Annual labor benefit expense	31	73,526	130,770
Annual operating expense (excluding labor and capital)	30	4,717,280	7,637,250
Average annual capital expense	29	188,691	262,585
Annual property tax expense	31	29,091	42,309

The number of farm employees is reported in Table 8. The survey asked for the number of people hired in both full time and part time positions. The part time positions were converted in full time equivalences. The 2011 the average number of FTE was 18.89 which is an increase compared to the 2006 survey. The 2006 survey reported 10.2 FTE employees per farm. The full

time equivalency on a per cow basis was 0.01932. Or in other words, each 100 cows required 1.932 employees. This is close to the 2006 result of 0.01975 employees per cow. This indicates that while the number of employees per farm changed between surveys the labor use per 100 cows was similar. This is consistent with farm herd size increasing and a small increase in labor efficiency.

Table 8. Survey Results – Number of Employees

Description	n	Average	Standard Deviation
Total FTE hired employees per farm	35	18.89	25.73
Employees per cow	35	0.01932	0.0167

Total employees is full time employees plus part time and seasonal employees converted to FTE

The survey asked questions to determine regional purchase coefficients for their dairy farm expenses. The dairies predominantly purchase inputs within Washington and locally. The survey estimates that 59 percent of dairy operating purchases are local within 30 miles of their operation. Thirty-three percent of the inputs are purchased regionally in Washington. For example, it is common for dairies to purchase hay from the Columbia Basin, which in many cases would be a regional purchase as opposed to a local purchase. Out-of-State purchases were estimated to be eight percent.

Table 9. Survey Results – Dairy Farm Regional Purchase Coefficients

	Percent
Locally (within 30 miles)	59
Regionally (over 30 miles but in Washington)	33
Out-of-State (mail order for example)	8

III. Washington Dairy Industry Economic Contribution Model

The agricultural sector in general and the dairy industry specifically, represents basic industries to Washington. Basic industries provide income to a region by producing an output, purchasing production inputs, services and labor. The production of dairy milk and processing products represent the direct economic contribution of the industry to the locality.

The dairy industry also generates indirect economic contributions as the revenues from the sales of dairy products are re-spent in the local economy. The indirect impact of the dairy industry on local economies includes purchases of a variety of agricultural inputs and professional services in the process of producing milk. Indirect effects represent additional economic activity in the local economy driven by dairy product sales. These effects appear as jobs and income in local industries serving the dairy industry (e.g., veterinarians, feed suppliers, implement suppliers, trucking and transport).

In addition to the direct and indirect impacts of the production and sales of dairy products outside of the region, the dairy industry is responsible for induced economic impacts in the form of the local goods and service purchased by people using the salaries and wages earned contributing to the productivity of the dairy industry. These induced expenditures translate into jobs and income for retailers, bank tellers, grocery store clerks, restaurant employees, and gas station attendants and so on.

The income generated directly by the dairy industry adds to this interdependency; dairy farm and dairy processing employees spend their wages and salaries on groceries, housing, entertainment, and a range of other consumer goods and services. Typically in the dairy farm and processing plant's local rural area generating rural economic development. In turn employees in these industries spend their income on consumer goods and services. These additional linkages, beyond dairy and indirectly related sectors of the economy, create induced effects, which help to form a complex intertwining of industries within Washington. So the relevant question to ask is not only what dairy adds to the Washington economy directly, but also how much do dairy farms contribute to Washington's economy through this complex networking of industries.

Methods

While the term impact is often associated with studies that consider the role of an entire industry or a set of industries in a region, this is improper terminology. A preferred nomenclature is economic contribution analysis Winter et al. (2007). An impact analysis considers the increase or reduction in total economic activity in a region due to some event like a new environmental regulation, a change in tax policy, or entrance of a new business. An economic contribution analysis is appropriate when considering the role that a set of industries play in a region's economy. This entails tracking all the economic activity that occurs downstream of an industry that can be attributed to that industry's presence in the region.

Input-Output (I/O) models calculate the economic impact of an industry through backward linkages. An industry generates economic activity by purchasing inputs from supplying industries in the region. If Industry A provides inputs into Industry B then the Industry B activity is not included in Industry A's contribution to the regional economy. With the dairy industry it is

important to recognize this distinction because there is a significant amount of economic activity generated through both forward and backward linkages. The post-farm gate industries that use a significant amount of raw milk as an intermediate input in Washington include "Fluid Milk and Butter Manufacturing", "Cheese Manufacturing", and "Dry, Condensed, and Evaporated Dairy Product Manufacturing". The logic for including these industries in an economic assessment of the dairy industry in Washington is that they are, in part, present in the state because there are dairy farms present in the state. If dairy farms were not present then consumers in Washington would buy milk products processed in another state that are then shipped into the state.

This study follows the logic of Stevens et al. (2005) which assumed milk to be a necessity with nearly perfectly inelastic demand. The implication of this assumption is that if there were no dairy industry in a region then consumers in that region would buy the same amount of dairy products but these would have to be imported from outside of the region. Those dollars represent a loss to the region.

The Input-Output model in this paper is based on the IMPLAN (Impact analysis for PLANning) ProfessionalTM (MPLANproTM) data and Version 3.0 software. The model represents Washington's economic structure for 2011, the latest available from IMPLAN for Washington.

In order to be consistent with standard I/O accounting, all expenditures in the dairy production enterprise budget must be converted to producer prices rather than purchaser prices. Margin tables were used to convert the enterprise budgets purchaser prices to producer prices. The final products that producers bought in purchaser price were separated into transportation, wholesale, retail margin, and producer price as is standard practice for Input-Output analysis. This was done by using information from the IMPLAN margin tables. Appendix Tables 1, 2 and 3 provide the I/O conversion information.

Results

According to the USDA, the value of raw milk production in Washington State for 2011 was about $1.274 billion. Figure 5 below shows the flow of raw milk through upstream processing industries both in and outside of Washington. These values were used to refine the existing estimates of the value of output for dairy farming and dairy processing, as well as the regional purchase coefficients and local use ratios in the I/O model. 1.4 billion pounds of raw milk is exported to other nearby states to be processed. The economic activity related to the production of this milk in the state is included in the analysis but there is no upstream activity attributed to it. No raw milk is directly consumed so the remaining 5.52 billion pounds of milk is used by the three dairy manufacturing industries shown. The transformation of raw milk quantities into gross sales for these industries is based on a combination of production coefficient estimates from IMPLAN and local industry experts and the Darigold Annual Report, 2011.

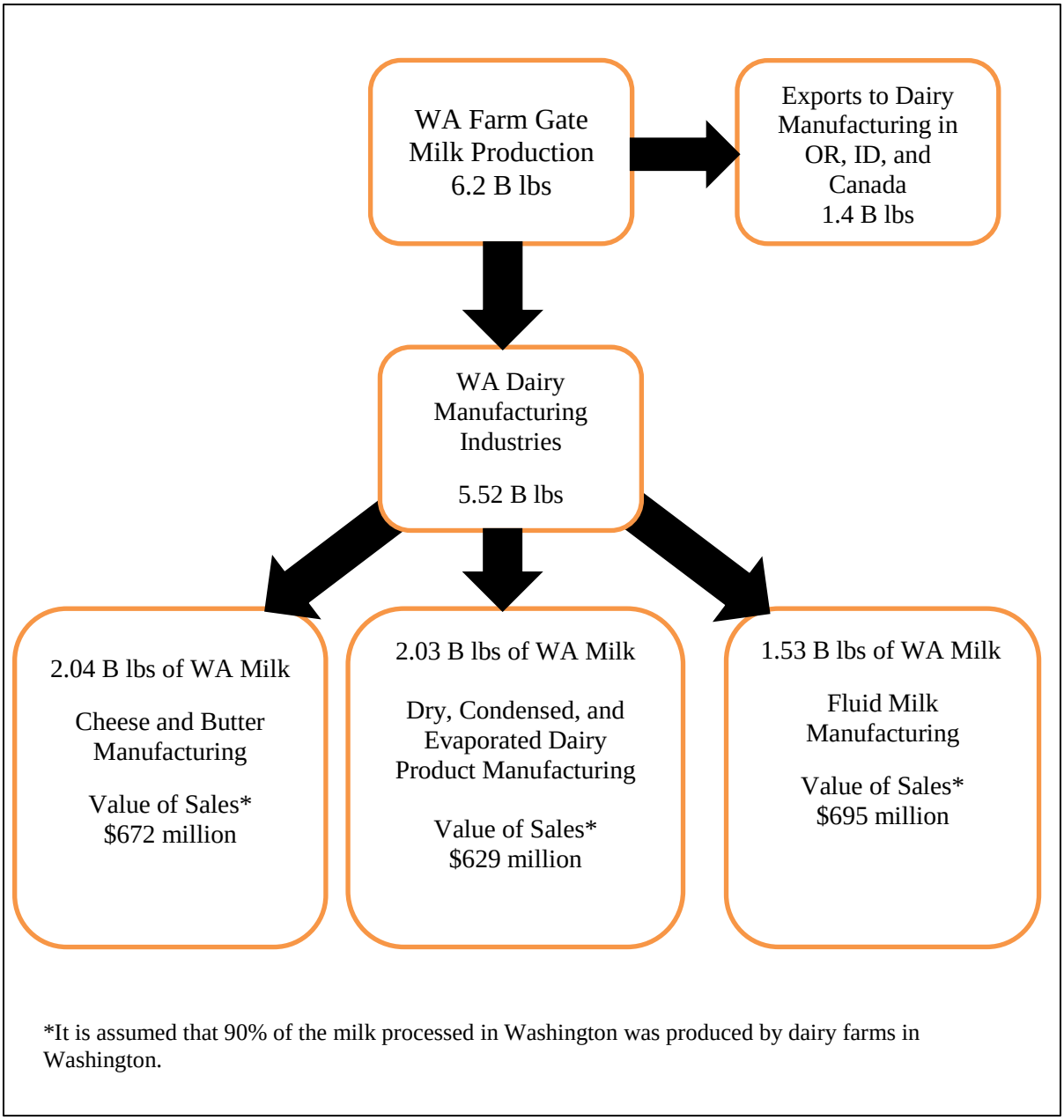

Figure 5. Flow of raw milk produced in Washington into upstream processing industries.

Results from the contribution analysis are listed separately for dairy farming and then dairy manufacturing industries. Because I/O models consider all backward linkages it is natural to include dairy farming in the summary of the dairy manufacturing industries. Another reason is that the dairy manufacturing industries locate near dairy farms so it makes sense to consider them together rather than looking at dairy manufacturing without dairy farming, which is a scenario that would be unlikely to happen.

Results from the contribution analysis are listed separately for dairy farming and then dairy manufacturing industries. Because I/O models consider all backward linkages, t is natural to include dairy farming in the summary of the dairy manufacturing industries. Another reason is that the dairy manufacturing industries locate near dairy farms so it makes sense to consider them together rather than looking at dairy manufacturing without dairy farming, which is a scenario that would be unlikely to happen.

Table 10 shows the estimates of the economic contribution of dairy farming. The total economic contribution for dairy farming alone is estimated to be about $2.363 Billion which is based on farm gate value of raw milk of about $1.275 Billion. This translates to a multiplier of 1.854. Total employment contribution is 12159. The 6,184 direct jobs can be converted to FTE by multiplying by 0.85, which gives 5,256. Indirect employment is primarily in other agriculture sectors including agricultural support industries. Induced employment is primarily in services sectors such as food, retail, and health services. In I/O models value added is the difference between gross sales and intermediate expenses. It represents the portion of sales that go to pay employees and pay certain taxes.

Table 11 shows the estimates of the economic contribution of dairy product manufacturing. The total economic contribution for dairy manufacturing alone is estimated to be about $2. 576 Billion, which is based on manufactured milk sales in Washington of about $1.996 Billion. This translates to a multiplier of just under 1.3. The total dairy manufacturing employment contribution is 4,497 jobs. Indirect employment is primarily in transportation and other manufacturing input sectors. Induced employment is primarily in services sectors such as food, retail, and health services.

Table 12 shows the estimates of the economic contribution of dairy cull cows at the processed level in Washington. The total economic contribution for processed dairy cull cows is estimated to be about $0.261 Billion. The economic contribution multiplier for dairy cull cows is about 1.949. The total dairy cull employment contribution is 1,409 jobs.

Table 13 shows the estimates of the economic contribution of Washington's dairy industry. The total economic contribution is estimated to be $5.201 Billion. This estimate is based on inputs of 90% (local use of local supply) of Washington's $1.996 Billion of raw milk production along with a small amount of imports of raw milk from neighboring states and Canada. The combined economic multiplier is about 1.527. The total employment contribution is estimated to be 18,066. The assumed production coefficients that describe the relationship between the value of raw milk inputs and the value of sales for the dairy manufacturing industries were customized based on information from industry experts in Washington, as was the estimate of the local use of local supply of raw milk.

Table 10. Summary of Economic Contribution of Dairy Farming in Washington

Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	6,184	71,612,578	388,676,231	1,274,640,000
Indirect Effect	4,221	186,121,549	358,466,996	852,922,255
Induced Effect	1,754	79,625,661	147,700,036	236,010,720
Total Effect	12,159	337,359,789	894,843,263	2,363,572,974

Table 11. Summary of Economic Contribution of Dairy Manufacturing in Washington

Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	1,012	75,718,896	134,805,754	1,996,401,877
Indirect Effect	2,047	135,549,421	214,632,335	386,212,380
Induced Effect	1,438	65,300,680	121,115,662	193,555,516
Total Effect	4,497	276,568,998	470,553,751	2,576,169,773

Table 12. Summary of Economic Contribution of Dairy Cull Cow Processing in Washington

Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	304	14,624,496	16,794,906	134,000,000
Indirect Effect	861	21,219,219	38,223,758	94,305,881
Induced Effect	244	11,077,288	20,544,776	32,834,034
Total Effect	1,409	46,921,003	75,563,440	261,139,915

Table 13. Summary of Combined Economic Contribution of the Washington Dairy Industry

Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	7,500	161,955,970	540,276,891	3,405,041,877
Indirect Effect	7,129	342,890,190	611,323,090	1,333,440,516
Induced Effect	3,437	156,003,629	289,360,474	462,400,270
Total Effect	18,066	660,849,789	1,440,960,455	5,200,882,662

Table 14 presents the top 10 industries by number of jobs related to dairy farming using the IMPLAN defined industry sectors. Support activities for agriculture have the largest number of jobs related to by dairy farming.

Table 14. Top 10 industries by number of jobs related to dairy farming

Industry	Employment
Support activities for agriculture and forestry	815
Real estate establishments	563
Wholesale trade businesses	452
Grain farming	295
Cattle ranching and farming	238
Food services and drinking places	236
Other animal food manufacturing	218
Transport by truck	185
All other crop farming	117

Discussion

Generating an estimated $5.201 Billion in total combined economic output contributions, and 18,066 jobs in 2011, the dairy farming and product manufacturing industries are a significant component to Washington's economy. Washington's dairy industry is in an increasing trend in herd size. As herd size increases and dairy farming economic contributions also increase. Milk price volatility has a critical role in the size of dairy farming economic contribution. Milk price has the single largest effect on dairy farm profitability. This modeling analysis used ninety percent of milk produced in Washington is processed in Washington. The dairy manufacturing sector produced an estimated total economic contribution of $2.576 Billion.

Comparing these results with numbers published by Cabrera et al. (2008) for New Mexico dairy farming in 2005, and Stevens et al. (2007) for a region of five states in the Southeast in 2005 are generally similar. For New Mexico the total dairy farming economic contribution was $1.98 Billion and had an output multiplier of 1.92. For the Southeast region the dairy farming output multiplier was 1.86 and for dairy manufacturing the output multiplier was 1.60. These multipliers are comparable the output multipliers reported here for Washington. For Washington the dairy farming output multiplier was 1.85 and for manufacturing it was 1.29.

IV. References

Neibergs, J.S. and David Holland, Economic Impact of Washington Dairy Farms: An Input-Output Analysis, Farm Business Management Report, School of Economic Sciences, Washington State University, 2007.

Cabrera,V.E., Hagevoort, D. Solı´s, R. Kirksey, and J. A. Diemer, "Economic Impact of Milk Production in the State of New Mexico". J. Dairy Science, 91:2144-2150, 2007.

Stevens, Thomas J., Alan W. Hodges, W. David Mulkey and Richard L. Kilmer, "Economic Contributions of the Dairy Farming and Product Manufacturing Industries in the Southeast United States in 2005. University of Florida, Institute of Food and Agricultural Sciences, Food and Resource Economics Department, Gainesville Florida. 2007.

Watson, Philip, Joshua Wilson, Dawn Thilmany, and Susan Winter, "Determining Economic Contributions and Impacts: What is the difference and why do we care?" Journal of Regional Analysis and Policy, Vol. 37, No. 2, 2007, pp. 140-146, 2007.

Appendix 1. Washington Dairy Federation and WSU Extension
2011 Dairy Economic Impact Survey

The purpose of this survey is to collect the basic information necessary to conduct an economic impact study of Washington's Dairy Industry using 2011 cost and return data. Your participation is needed to produce study results that can be used to promote Washington's dairy industry. The information provided will be maintained in a confidential manner. If you have any questions on the survey please contact Jesse Robins, Washington Dairy Federation 360 482-3485 or Shannon Neibergs, WSU Extension, 509-335-6360, sneibergs@wsu.edu.

Demographic and Operation Description

1. Zip code your dairy is located in _____ 2. How long has the dairy operated at this location? _____ (years)

3. How many cows do you milk _____(head) 4. What is your average daily milked shipped _____ (cwt)

5. Do you raise crops (for example hay, grain or silage) that are used as feed in your dairy (check) ____ yes or ____ no

6. Do you raise crops that are sold off of the farm (check) ____ yes or ____ no

7. Approximately how many acres in your dairy are:

	Owned	Leased
Pasture		
Cropping		
Nutrient Management (not included above)		
Other (Buildings, forest, etc)		

Labor and Benefit Information and Expenses

9. What is your estimated total annual hired labor expense for the dairy? (do not include benefits) $_____

10. What is your estimated annual labor benefit expense (eg. workers comp., social security, insurance)? $_____

11. Please complete the table of employment information for your dairy operation:

	Number Employed as	Estimated average percent of full time employment	Estimated average annual amount paid**
Full time year round – category 1*		100%	
Full time year round – category 2*		100%	
Part time year round			
Seasonal labor			
Family labor not included above			

* Categories 1 and 2 are to separate full time higher paid eg. a foreman versus full time lower skilled/paid labor
** Annual salary for full time for part time just what you pay them in a year. Do not adjust part time to a full time wage.

12. What benefits do you provide?

	Benefit Provided (check)	If yes, number of employees provided	Estimated annual cost per employee
Workers Compensation	Yes ____ No ____		
Health Insurance	Yes ____ No ____		
Housing	Yes ____ No ____		
Transportation	Yes ____ No ____		
Other _____	Yes ____ No ____		

2011 Dairy Revenues

8. What are your annual 2011 revenues for each of the following dairy categories:

Milk / Farm Sales		Livestock Sales	
Milk sales	$	Cull Cows	$
Other dairy income	$	Calves	$
Crop Sales	$	Replacement Heifers	$

2011 Dairy Operating Expenses

13. What is your estimated total annual cost of operating your dairy (excluding labor and benefits given above and excluding capital depreciation expense).

$ _____

16. For your annual total dairy expenses in a typical year please estimate the percent of the total that is spent:

Locally (25-30 miles) _____%

Regionally (over 30 but in Washington) _____%

Out of state (mail order for example) _____ %

Total adds to 100% 100%

2011 Dairy Capital Expenses (Capital refers to facilities, equipment – machinery and cow replacements)

15. How many heifer replacements do you raise _____ and/or purchase _____ (head) for your dairy.

If you purchase heifer replacements what is the typical total annual expense $_____.

17. Considering the past five years, what has been your average annual capital investment? (excluding replacements above)

$ _____

18. Are you planning a major capital expansion to expand or invest in your dairy in the next five years? ____ yes ____ no. If yes, please identify the expansion focus and capital cost, or if no please identify if any expansion constraints exist.

_____ Estimated expansion capital cost $_____

19. Estimated annual property tax expense $_____

20. For your dairy, please rank the following issues from **1 = not** important to **5 = highly** important by circling number.

Environment	1 2 3 4 5	Real estate development	1 2 3 4 5	GMO feeds	1 2 3 4 5
Urban encroachment	1 2 3 4 5	Animal well being	1 2 3 4 5	Labor	1 2 3 4 5
Gov. milk price order	1 2 3 4 5	Nutrient management	1 2 3 4 5	Herd health	1 2 3 4 5
Feed costs	1 2 3 4 5	Estate planning	1 2 3 4 5		1 2 3 4 5

Thank you for taking the time to complete this survey. Your participation is critical to the success of this project, and your effort is appreciated. Please return the completed survey using the enclosed return envelop, or to:

WA State Dairy Federation,
P.O. Box 1768, 575 E. Main St.,
Suite #2, Elma, WA 98541-1768,
PH: 360-482-3485

Appendix Table 1. Annual Revenues and Costs per Cow

Income[1]	**$ per cow**
Milk sales ($20.70 cwt * 237.27 cwt)	4,911.49
Cull cow (per cow)	259.93
Calf sales (per cow)	56.61
Other	195.85
Gross Income	$5,423.88
Variable Costs	
Grain protein mix	1,315.31
Corn silage	401.94
Hay - alfalfa	625.95
Salts and minerals	59.14
Calf starter	56.02
Total Feed Costs	$2,458.36
Veterinary health	80.92
Utilities, water, etc	74.22
Fuel	163.18
Professional services	25.41
Breeding fees	52.13
Supplies, misc	180.55
Repairs	202.83
Bedding	20.67
Milk hauling	229.00
Milk check-off	35.59
Interest	67.76
Labor	466.55
Labor benefits	75.21
Total Feed and Variable Costs	$4,132.38
Fixed Costs	
Rent and leases	232.52
Annual capital cost	360.00
Property taxes	29.76
Insurance	14.60
Total Fixed Costs	$636.88
Total Cost	**$4,769.26**
Income over all costs	**$654.62**

[1] Source 2011 Dairy Economic Impact Survey
Milk yield adjusted from survey responses to USDA reported yield

Appendix Table 2. Washington Dairy Farm Production Function in Input Output Accounting Framework

Sector Names	Dairy Farm Output per Milking Cow	Dairy Farm State Aggregation
Inputs	$	$
Grain Protein Mix	1,315.31	345,926,530
Corn silage	401.94	105,710,220
Hay - alfalfa	625.95	164,624,850
Salts and minerals	59.14	15,553,820
Calf starter	56.02	14,733,260
Veterinary inputs medicines, supplies	40.92	10,761,960
Veterinary Services	40.00	10,520,000
Professional services	25.41	6,682,830
Utilities, water, etc	74.22	19,519,860
Fuel	163.18	42,916,340
Breeding Fees	52.13	13,710,190
Supplies, misc	180.55	47,484,650
Bedding	20.67	5,436,210
Milk hauling	229.00	60,227,000
Check-off (separated)	35.59	9,360,170
Insurance	14.60	3,839,800
Repairs	202.83	53,344,290
Rents and leases	232.52	61,152,760
Total Inputs	3,769.98	991,504,740
Value Added		
Employee compensation	541.76	142,482,880
Proprietary income	865.90	227,732,542
Other property income	216.5	56,933,135
Indirect business taxes	29.76	7,826,880
Total Value Added	1,653.90	434,975,437
Total Industry Outlay	5,423.88	1,426,480,177

Appendix Table 3. Dairy Farm Production Function Input and Their Associated IMPLAN Sector.

Sector Names	IMPLAN Sector Number	IMPLAN Sector Description	State Aggregation
Inputs			$
Grain Protein Mix	47	Animal Food Manufacturing	345,926,530
Corn silage	2	Grain Farming	105,710,220
Hay - alfalfa	10	All other crop farming	164,624,850
Salts and minerals	47	Animal Food Manufacturing	15,553,820
Calf starter	47	Animal Food Manufacturing	14,733,260
Veterinary inputs medicines,	160	Pharmaceutical and medicine	10,761,960
Veterinary Services	449	Veterinary Services	10,520,000
Professional services	455	Business Support Services	6,682,830
Utilities, water, etc	30	Power generation and Supply	19,519,860
Fuel	142	Petroleum Refineries	42,916,340
Breeding Fees	18	Agriculture support activities	13,710,190
Bedding	112	Saw mills	5,436,210
Repairs	42	Maint. of Farm and non farm	53,344,290
Supplies, misc	257	Farm Equip and Mach. Mnfc.	47,484,650
Milk hauling	394	Truck Transportation	60,227,000
Check-off (separated)	447	Advertising and Related Services	9,360,170
Insurance	428	Insurance agencies and	3,839,800
Rents and Leases			61,152,760
Value Added			
Employee compensation			142,482,880
Proprietary income			227,732,542
Other property income			56,933,135
Indirect business taxes			7,826,880
Total			1,426,480,177