

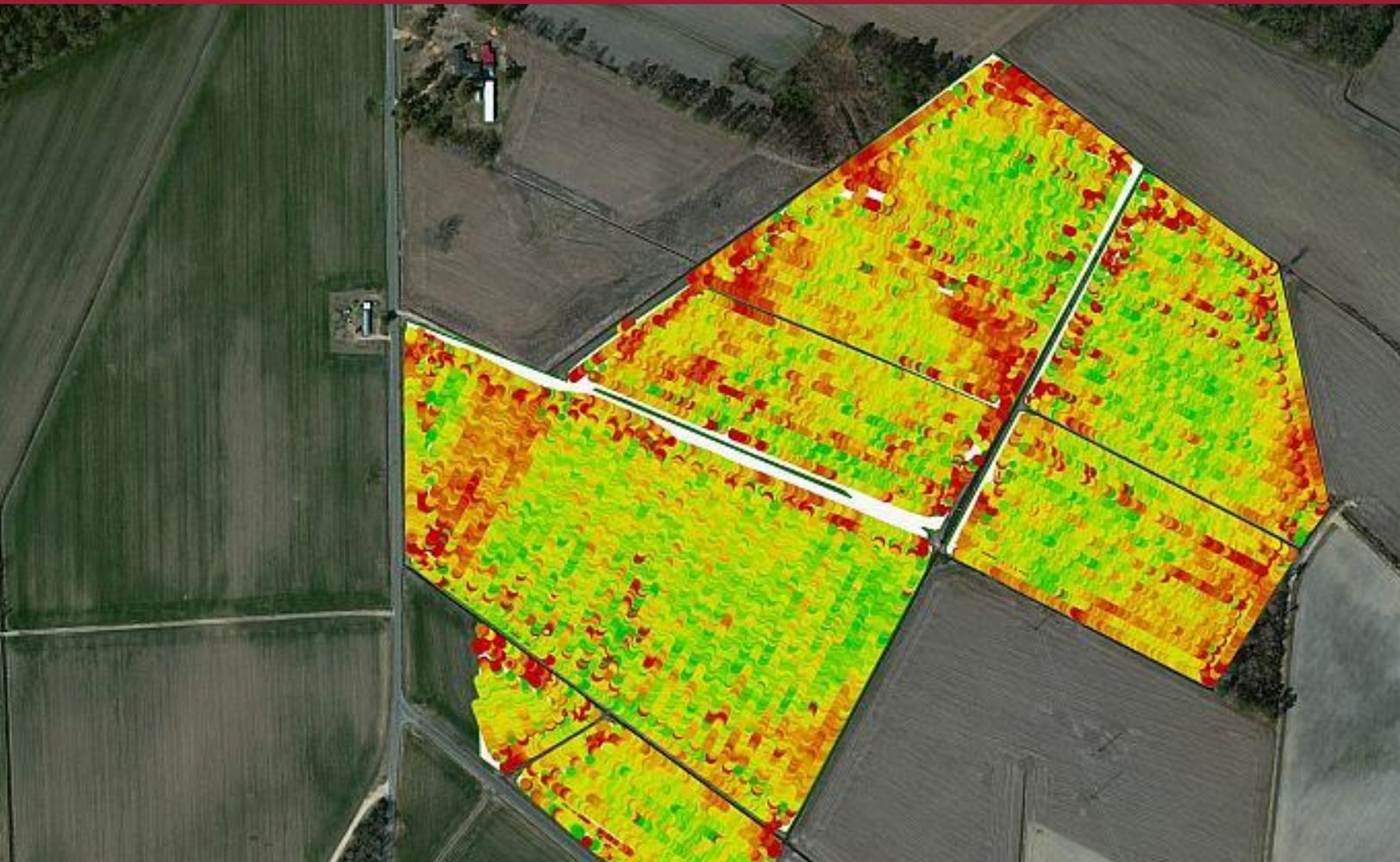


IMPACT Center
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2023 WASHINGTON STATE BROADBAND & REGIONAL AGRICULTURE:

OUTPUT AND COST REDUCTIONS FROM ACCESS AND UTILIZATION

A report by Washington State University's IMPACT Center



2023 WASHINGTON STATE BROADBAND & REGIONAL AGRICULTURE

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Acknowledgement:

We are grateful to Ryan Holterhoff, Sr. Policy Analyst Grant County PUD, who initially brought this project to us and transferred research authority to the IMPACT Center. We also thank Senator Warnick and her staff for securing the funds and maintaining interest in the outcome of the research throughout the development and execution of the project. We wish to thank Connie Rivera and Jason Freeze from the Broadband Office for their oversight and help in dealing with the administrative side of the contract. Lastly, we are grateful to the farmers, implement dealers, manufacturers, and technicians we spoke with over the past several years. Their insight helped us to understand the mechanisms by which the new technology adoption translated into economic returns.

This research was sponsored by the Washington State Broadband Office under Contract Number: 23-96810-003

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1. Introduction and Background

Precision Agriculture has historically been associated with resolving soil variability and is aligned with soil science and agronomy at its core. Much of this work has been accomplished within developed agricultural regions, resulting in more uniform and less discrete production variability. As such, new factors become key in increasing production quality and quantity. Precision agriculture has moved to computationally intensive optimization problems (See). Soil science is now being augmented by data science in the agricultural arena.

Washington State is not immune to these changes and is, in many ways, leading the charge on the data science efforts in agriculture. Automation, once relegated to processing, has moved into the warehouse and storage segments, and fully automated dairies now exist where cows are fed and milked when they chose and quite independent of the farmer. A combine's sieve and chaffer settings can be managed offsite, sometimes hundreds of miles away, and yet in real time. Center pivots with mechanical optics identify insect infestations or plant degradation allowing for precision spraying of insecticides, herbicides, or other soil amendments.

In late 2022 The Washington State Legislature allocated funds through the State Department of Commerce's Broadband Office to have the WSU IMPACT Center evaluate how the broadband infrastructure advancements have influenced agriculture and assess to what extent the agricultural economies of various regions within the state have benefited, if at all. What follows is a synopsis of the contributions of broadband access and precision agricultural implementation within Washington State and a series of regional reports assessing the same thing within those regions.

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2. Washington State Agricultural Summary

Because Washington agriculture is so diverse and covers so many crops and animals, including a large amount of aquaculture and commercial fishing, it is too much to report all the agricultural commodities produced and sold. Farm receipts and total expenses are captured in the Farm Income and Wealth statistics from USDA, and we use those to isolate the baseline annual agricultural farm gate values. While much of this data can be provided back to 1929, a comprehensive data set doesn't appear until the 50's. We show the real data from 2023 in Table 2.1, and a time series charts from 2000 forward of key variables appears in Figure 2.1. Again, these data are reported in real, rather than nominal terms so that issues of inflation may be avoided.

Table 2.1: A Decade of Change in Washington Net Farm Income (\$1,000 Real 2024 dollars)

	2013	2023	% Change
Gross cash income	13,672,378	15,264,719	12%
All commodity receipts	12,813,580	12,354,614	-4%
Crop receipts	9,156,086	7,950,172	-13%
Animals and products receipts	3,657,494	4,404,442	20%
Cash farm-related income	605,709	2,689,304	344%
Forest products sold	29,345	49,940	70%
Machine hire and customwork	126,793	39,290	-69%
Other farm income	449,572	2,600,075	478%
Direct government payments	253,089	220,801	-13%
Cash expenses 1/	10,151,755	13,813,232	36%
Interest 1/	368,990	610,540	65%
Nonreal estate	139,540	273,482	96%
Real estate 1/	229,451	337,058	47%
Labor expenses	2,376,804	4,733,636	99%
Property taxes and fees 1/	301,187	273,282	-9%
Farm origin	1,783,183	2,637,448	48%
Feed purchased	1,111,376	1,261,435	14%
Livestock and poultry	208,734	935,023	348%
Seed	463,073	440,989	-5%
Manufactured inputs	1,996,339	1,934,938	-3%
Electricity	189,847	198,185	4%
Fertilizer and lime	780,609	687,123	-12%
Fuel and oil	443,734	413,784	-7%
Pesticides	582,149	635,845	9%
Other intermediate expenses 1/	2,666,586	3,220,222	21%
Net rent to landlords 2/ 3/	658,665	403,167	-39%
Net cash income	3,520,623	1,451,487	-59%

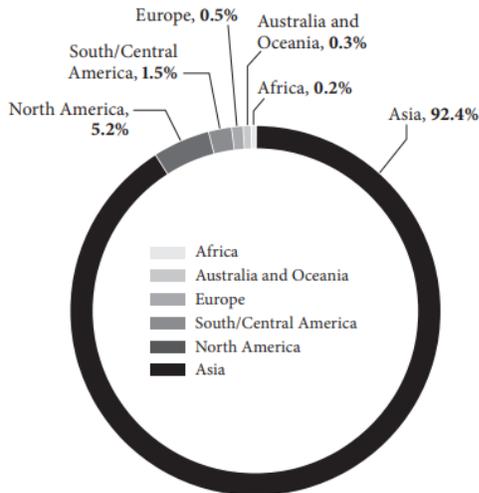
Source: USDA ERS Farm Income and Wealth Statistics September 2024

Roughly 55% of total output is attributable to the top five agricultural commodities produced in the state, Apples, Wheat, Potatoes, Milk, and Cattle production. The majority of these products are exported either directly as raw commodities, for further processing abroad, or as processed commodities ready for consumption.

Of Washington's roughly \$12 billion in sales, nearly half, 49.3%, is sold directly as exports. The remaining half is typically sent to local processors before being exported to other states and foreign nations. The

following figure shows the percent of Washington agricultural exports by continent. Given global geography it is not surprising that Asia is Washington's primary foreign market (92.4%), with Canada and Mexico in North America capturing 5.2% of Washington agricultural exports. Asia has one of the highest continental growth rates in the world, suggesting market stability for Washington. Digging deeper into the data, however, shows a very different and troubling picture.

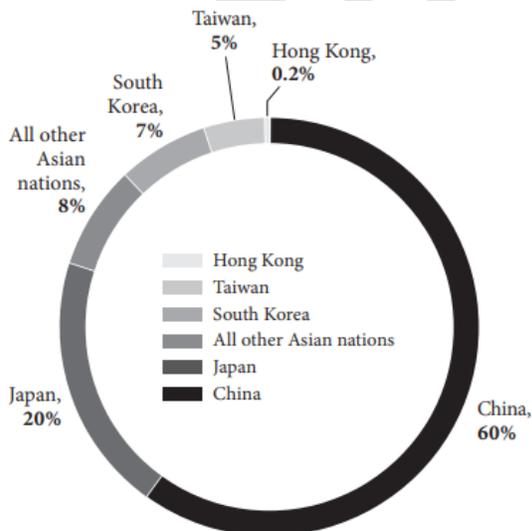
Figure 2.2: Washington Agricultural Export Shares by Continent



Source: Census, IMPLAN, and Author's calculations

U.S. Census partitions Asia into the Near East (south of Turkey and west of Afghanistan), South (from Afghanistan to Bangladesh) and Other (China to Indonesia, and east to and including Japan). The bulk, 87%, of our Asian exports are captured by just five nations: China (59%), Japan (16%), South Korea (7%), Taiwan (4%), and Hong Kong (0.2%). This emphasizes a need for diversification in Washington's foreign market portfolio for agriculture.

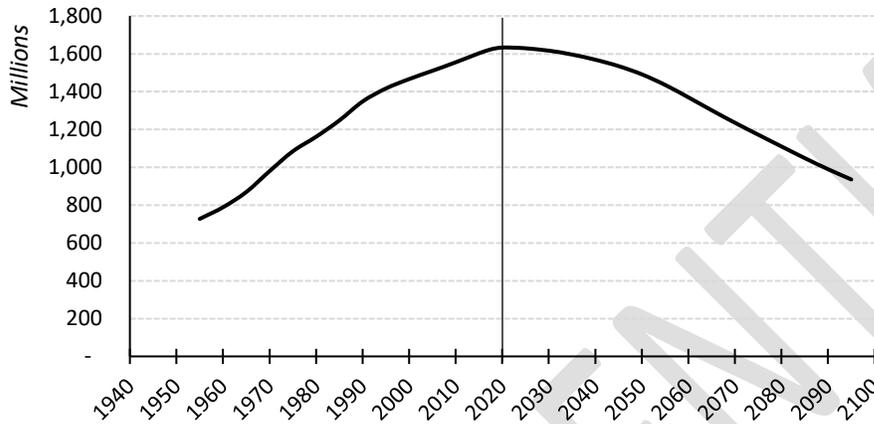
Figure 2.3: Washington Agricultural Export Shares by Asian Nation



Source: Census, IMPLAN, and Author's calculations

These markets are the largest markets in Asia aside from India. The concern is that nearly all the population growth in Asia is being driven by India and the Muslim majority nations, none of which are notable entities within Washington’s foreign market portfolio. It is true that the food manufacturing that takes place in our five primary foreign markets are capital, rather than labor intensive. And thus, production can continue amidst a population decline, but demand will begin to fall in the Asian domestic markets as population wanes.

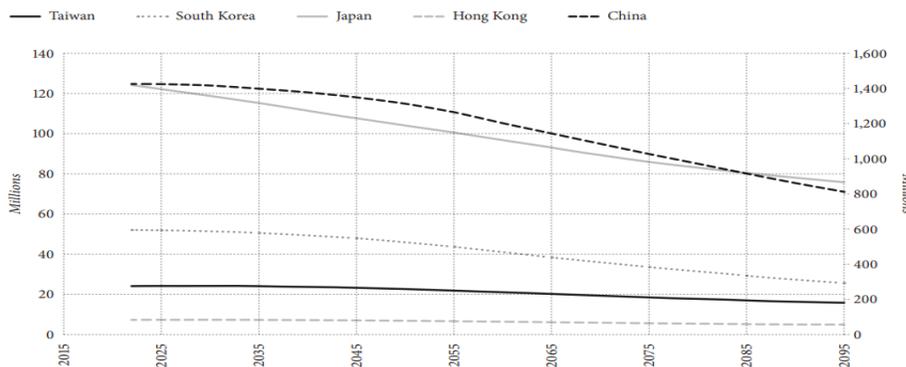
Figure 2.4: historic and forecasted combined population of China, Japan, South Korea, Taiwan, and Hong Kong



Source: World Population Review

Over the next 50 years our primary Asian markets are expected to lose nearly 500 million people. Roughly 50% of Washington’s agricultural market is currently based in the U.S. with a population of roughly 330 million people. Washington’s five primary Asian trading partners represent nearly the entirety of the other 50% of Washington’s agricultural market and they are expected to lose more than the population of the United States over the next 50 years. The population decline in these five nations represents roughly 28% of their total current population. All five nations are currently in a population decline, with Japan already 12 years into their decline. Japan has already lost over 4 million people since its peak in 2010 and is currently losing population at a rate of one person every 48 seconds. The following figure shows the population trajectory of each of the five nations with China being captured on the secondary vertical axis.

Figure 2.5: Forecasted Population trajectory of top five Asian buyers of Washington Agricultural goods.



Source: World Population Review

3. Data and Methodology

Data from the FCC on connectivity and speed, collected in Form 477, provides a geographic breakdown of broadband access and utilization. We pair that data with crop yield and cost data from USDA. This process on that of LoPiccalo (2021). Our research focusses on the fact that broadband access and utilization on farms is designed for cost curtailment rather than yield or revenue gains. While LoPiccalo finds evidence of yield differentials, we find in Washington that yields and costs are affected, thus enabling us to determine how overall farm profitability is affected.

These estimates provide us with the direct effects needed for running our I-O model in each region and for the state contribution model. Gains in revenue are shocked as increased exports, which bring new dollars into the region or state. Reductions in costs are captured as gains in owner income via the household sector of the I-O model. Both shocks combined provide total direct contributions that can be traced back to broadband infrastructure.

It is important to note that in the context of our analysis the sum of the regional contributions will not equal the state contributions. Contributions are based on the exports of products from the region of analysis. Potatoes grown in Okanogan may be exported from the county for processing but not exported from the state. Thus, state exports tend to be lower than the sum of regional exports. The dollars on the other hand tend to circulate within the state longer than the circulate within a county. Columbia county may bring dollars into the county from exporting wheat, but those same dollars are likely to leak out of the county quickly as purchases for non-locally manufactured goods are purchased.

3.1 Regional Input-Output Analysis

This section of the report describes the input-output model used for assessing the extent broadband access and precision agriculture utilization in Washington's economy influenced agricultural output and cost curtailment. It incorporates the data and financial descriptions from the previous chapter into the IMPLAN model and calculates the contributions broadband has had in generating Sales, Gross State Product (GSP), household income, and employment. It is important to note that insofar as broadband access increased sales and exports of commodities through yield shocks, the direct effects are entered as such, increased exports. However, cost reductions accrue to farmers through increased net farm incomes, i.e., profits. These incomes enter the model as increases in the farmer's household income and expenditure profiles

Basic industries provide income to a region by producing and *exporting* their output. Out-of-state expenditures on Washington agriculture represent new dollars, otherwise known as financial injections, into the state's economy. This is the standard approach for most agricultural contribution analysis. However, cost reductions in Washington agricultural expenditures impacts the state largely through the *retention and circulation* of dollars within the economy. This function of circulating money in the economy is commonly known as "deepening" the economy, since it prevents money from coming in and immediately exiting the market. As the money circulates within the economy it creates jobs and incomes throughout the state's supply chains.

Basic vs. Non-Basic Impacts: Which Industry Supports the Economy?

A small agricultural town may seem to have a large medical industry in terms of employment, while the number of farm employment is fairly low, and often seasonal. However, the farms are exporting their product and bringing money into the economy. The doctor's offices are predominantly serving the residents. In this story, it is the farmers that are supporting the economy and the doctors are retaining the money within the economy. However, it should be clear that the farms would continue to exist in the absence of the doctor's offices, while the doctor's offices would not be likely to stay in the absence of the farms. In this setting, the non-basic medical jobs rely on the basic agricultural jobs. The employment impacts, including many of the doctors and nurses, would be attributed to the non-basic agricultural industries.

This story gets more complex in the case of apples, potatoes, etc. where processing occurs near the primary commodity input. We structure these models to show the interdependency of the grower and processor and assume the grow operation is the dominant basic force. This is similar to coal mining or fishing operations where processing, forward links in the supply chain, is forced to locate near the source of the commodity.

Increased yields and associated exports, as well as cost savings represent the *direct* contributions of broadband access and utilization to Washington. However, these dollars gained and saved generate *indirect* contributions as well as they flow through the economy supply chains. Once a commodity is sold, some portion of that revenue will be spent on electricity, for example. A portion of the revenues received by the utility industry will then be spent on a new turbine from a manufacturing industry, etc. And so, the dollar that was brought into or retained in the economy as a result of broadband access and utilization circulates through many businesses throughout the state, all the while generating sales and incomes. Indirect effects represent additional economic activity in Washington's economy driven by the business-to-business transactions stemming from broadband infrastructure and the farm's utilization thereof.

In addition to the direct and indirect impacts are the *induced* economic contributions, captured in the form of local goods and services purchased by households. As farm owners and their employees spend salaries, wages, and profits in the state economy those household-to-business transactions ripple through the economy. These induced expenditures represent the households' supply-chains and translate into jobs and income for retailers, bank tellers, grocery store clerks, restaurant employees, gas station attendants, and so on. Typically, these expenditures occur locally, generating urban and rural economic development. These additional linkages, beyond the farm, help to form a complex intertwining web of industries and institutions within Washington. So, the relevant question to ask is not only what broadband access and utilization contribute to the farms, but how the Washington economy as a whole benefits through this complex networking of industries.

Input-Output models are designed to capture the entirety of this complex networking of industries and institutions. In this case it serves to show what portion of that economic web is dependent on agricultural utilization of the broadband infrastructure. To that end, this section of the report covers the technical aspects of the model and the nuances made to various components of it in order to ensure its accuracy. We begin by explaining the basics of any input-output model as well as the data used for this

particular analysis. Next, we discuss how the model needed to be modified to ensure there was no double counting when evaluating the contributions of the production vs. processing components of the sector. Lastly, we outline the direct effects, sometimes referred to as the shock to the economy. The subsequent multiplier effects and total contributions are reported at the end of the section.

Basics of Input-Output Analysis

The system of accounts known as Input-Output (I-O) tables represent an economist’s version of double-entry bookkeeping for industries. Figure 3.1 below shows a simplified version of an I-O matrix with just a hand full of industries. Each cell, in this table of accounts, is populated by dollar transactions.

Figure 3.1: Aggregated form Input-Output Matrix

		Producers as Consumers					Final Demand				
		Agric.	Min.	Const.	Manuf.	Services	Other	Households	Investment	Government	Net exports
Producers	Agric.										
	Min.										
	Const.										
	Manuf.										
	Services										
	Other										
Value Added	Labor							Gross Domestic Product			
	Returns to Capital										
	Taxes										

Reading down a column of this table shows what inputs an industry is buying in order to produce their output. The Agriculture column, for example, may buy seeds from themselves, fertilizer and farm equipment from the manufacturing sector, and legal and accounting services from the service sector, not to mention broadband access from an ISP and an implement dealer. Payments to employees are captured in the “Labor” row. Payments must be made to owners of capital, and the industry pays taxes to the government. This is where the expenditure data enabled us to isolate operations. Reading across a row tells us where an industry’s income originates.

Summing all the labor, capital, and tax payments for all industries gives the sum of all value-added and will equal the Gross Regional Product (GRP) of the region.² Similarly summing all of the expenditures of households, government, investment, and net exports yields the GRP of the region. These two methods of calculating GRP are known as the Income and Expenditure approaches, respectively, and they

² In our case the region is Washington State.

represent a check for ensuring all accounts balance. It is through the I-O system that we are able to trace the dollars through the economy, quite literally following the money. It is through this tracing of dollars that we are able to calculate multiplier effects associated with the broadband access and utilization by the agricultural sector. Both exports and farmer's incomes increase, both positively influencing GDP.

Model and Sector Modifications

One of the primary concerns when doing economic contribution studies is the potential for double counting. If we were to claim all the agricultural sales within the state, rather than just the sales of the final goods, we would be double counting certain values e.g., the value of apple sales from the grower/processor to the retailer would be captured twice. This double and, sometimes, triple counting of the sector supply chain has to be prevented for an accurate analysis. However, we cannot claim only the direct effects of the sector either. Doing so would miss the impacts of a deep statewide supply chain. To capture all contributions through the supply chain and prevent the double counting issue, we can sever the expenditure link between the industries within the sector (Steinback 2004). We accomplished this through the aggregation of the sector and elimination of intra-sectoral purchases, only capturing the sales of goods to the final consumer.

The other important component in avoiding double counting is to report value-added, also known as gross state product (GSP), rather than sales. Though the model is built on producer prices and sales transactions, summing up all sales receipts will overstate the actual productivity of a region. If a grower produces potatoes, which are sold to a processor, the processor sells frozen fries to a retailer, and the retailer sells them to a consumer, the value of the potato is being incorporated and captured in each round of transactions. To prevent this type of double, triple, and quadruple counting we report contributions on a value-added basis. The following text box describes why sales is not an appropriate metric for reporting contributions.

Sales vs. value-added

A way to explain why sales overstates contributions is to imagine individuals spending money in a regional economy. Suppose an individual spends \$40,000 on a new truck. Another individual spends the same amount on an appendectomy at the regional hospital. From a sales perspective, the contributions are the same, \$40,000. However, from a value-added perspective the purchase of the truck provides less to the regional economy. Perhaps \$30,000 of the truck purchase had to immediately go to the manufacturer back in Detroit or Japan. Conversely, the appendectomy at the hospital probably saw most of the spending stay local as income to the doctors, nurses and hospital staff. Perhaps only \$10,000 leaves the region for importing of capital assets like the hospital bed, scalpels, etc. From a value-added perspective, the hospital is more valuable than the auto dealership even though they are equivalent from a sales perspective.

Because the broadband infrastructure is non-basic in nature, we must build our model in an import-substitution framework rather than the more traditional export-base framework. The assumption underlying this model is that contributions are based on retaining monies that otherwise would have exited the economy for the importation of goods and services. When farmers reduce their costs of production those monies that would have otherwise exited the economy are retained as farm income and continue to circulate in the region. For a full explanation of the distinctions of such models, readers should refer to Cooke and Watson (2011) and Arrow (1954).

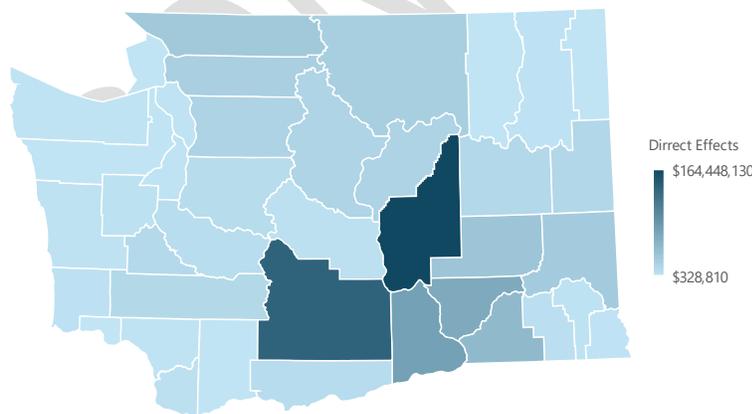
3.2 Data and Direct Effect Estimates

Our primary data sources for estimating both the cost reductions and revenue enhancements from broadband comes from the FCC’s Form-477. This data set reports on both fixed and mobile providers. Fixed broadband providers provide services that terminate in a specific premises or geography. It may provide that service to a wireless channel as is common in household networks. Because of the geographic termination of fixed service providers reporting is done on a census block data formation. Mobile broadband service providers have mobile device end users. Mobile services data is reported via GIS centroid data and is associated with shape files.³ The FCC’s CC Docket No. 98-146 notice of inquiry they state “Each [Form 477] filer provides data on the number of lines or wireless channels by technology (service provided on coaxial cables, on wireline telephone lines, etc.) and by zip code. These standardized data enable us to track deployment by different kinds of providers and technologies as well as the growth in subscribership overtime.” Data on Form 477 may be viewed or downloaded at <https://www.fcc.gov/general/broadband-deployment-data-fcc-form-477>.

USDA data on agricultural sales, yields, and costs by county comes from National Agricultural Statistics Services. We collected farmgate sales and cost data by year and county. All dollar denominated values are converted to real terms. In order to collect county level fixed effects, we use Lightcast to organize population, employment, income, age, and demographic data, we also use their business establishment and 2-digit industry data.⁴

The fixed effect model is run as $A_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 BB_{it} + \beta_3 \gamma_t + \varepsilon_{it}$, where A_{it} is the agricultural output or expense value, the X_{it} is the set of county fixed effects, BB_{it} is the broadband access variable of interest and γ_t is the time fixed effect. In the specification the i represents the county and t represents the time period. The β_2 estimates generate the county level production and cost reduction returns Figure 3.2 shows the data graphically and the raw data can be seen in Appendix A

Figure 3.2: Reductions in Ag Costs and Increased Output



³ See https://apps.fcc.gov/edocs_public/attachmatch/DA-16-1107A1_Rcd.pdf for more on the centroid methodology.

⁴ We use Lightcast rather than the various government data systems in order to have a consistent data set that is unsuppressed at the county level.

4. Washington State Broadband Contributions via Agriculture

The direct effects outlined in Section 3.2 were captured in the agricultural and household vectors of the IMPLAN Input-Output model. Table 4.1 shows the results of the broadband utilization impacts on the direct farming operations as well as the indirect and induced portions of the state economy. We highlight the GDP column of the table to indicate it as the true economic impacts attributable to broadband's role in the 2023 agricultural production cycle.

Table 4.1: Total Economic Contributions of Broadband in Washington Agricultural Production

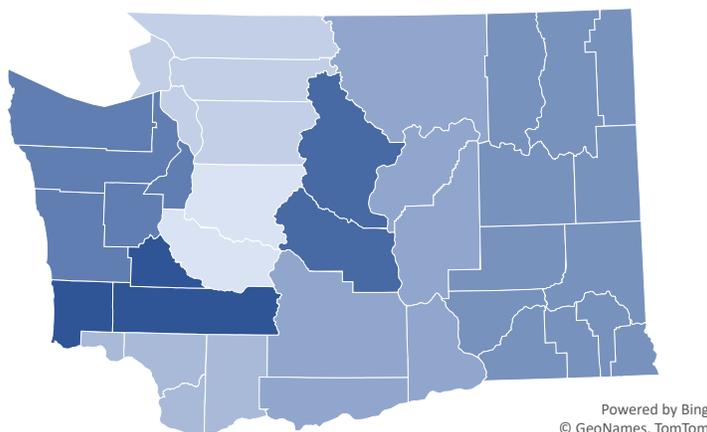
	Sales	GDP	Income	Jobs
Direct	\$584,353,757	\$383,006,375	\$237,262,253	5,662
Indirect	\$210,862,512	\$118,799,250	\$74,959,626	1,117
Induced	\$277,597,862	\$174,483,769	\$92,915,877	1,515
Total	\$1,072,814,132	\$676,289,393	\$405,137,757	8,294

Source: IMPLAN and Author's Calculations

In addition to the direct \$383 million in direct on farm gains from Broadband access and utilization, \$118.8 million in indirect business-to-business transactions also occurred as a result of broadband and another \$174.5 million in farm income and induced household-to-business transactions. Without the broadband infrastructure in place, it is reasonable to think the Washington agricultural sector of the economy would have been \$676.3 million smaller than it was in 2023. That represents roughly 0.1% of the state's overall GDP and nearly 5% of the agricultural production economy, not inclusive of processing.

One must understand that the Statewide impacts are substantially less than the sum of the region impacts outlined below. The reason for this is that substate regions may export their products out-of-region, but in-state. This means the sum of regional exports will exceed the state exports in any given year. This is somewhat offset by the fact that the indirect and induced multipliers are higher at the state level as the dollars will circulate in the state longer than in any given sub-state region before leaking out for the purchase of imports. Readers are cautioned not to make spurious comparisons between regional impact numbers. Figure 5.1 shows the seven primary regions discussed in the following chapter. Note that these regions conform loosely to the state's congressional regions, though the densely populated areas of King and Pierce counties are captured separately within the state level analysis just discussed.

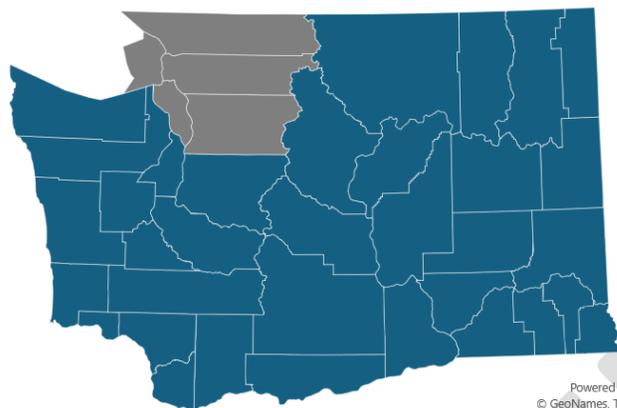
Figure 5.1: Regional Descriptions for Broadband Assessments



5. Regional Results

Region 1:

This Fact Sheet provides the economic overview of broadband availability and the associated agricultural impacts in the five-county region of Island, San Juan, Skagit, Whatcom, and Snohomish Counties.



Broadband access in this region has evolved over the years in terms of access, quality, and adoption. The primary crop land in the region is Grass Hay (24%), Shellfish (20%), Pasture (14%), Corn, Field (9%), Blueberry (4%), and Other (28%).⁵ Total agricultural value of all commodities produced in the region has grown from \$784 million to \$1.2 billion over the last decade.

Table 1 shows the estimated values of select commodities produced in 2023 by county within the region. Table 1 only lists a set of the key commodities produced and, as such, does not reflect the entire value of agricultural production. Shellfish and Pastureland, for example, are not included.

Table 1: 2023 Region 1 Production Value Estimates by County and Commodity

County	Island	San Juan	Skagit	Snohomish	Whatcom	Regional Total
Wheat	\$17,596	\$30,667	\$1,221,658	\$135,237	\$264,441	\$1,669,600
Barley	\$349,237	\$35,189	\$3,099,313	\$311,392	\$49,132	\$3,844,264
Apples	\$105,965	\$381,476	\$529,827	\$837,127	\$614,600	\$2,468,996
Cherries	\$0	\$15,031	\$0	\$7,515	\$0	\$22,546
Pears	\$0	\$15,974	\$87,857	\$23,961	\$0	\$127,792
Potatoes	\$461,555	\$0	\$69,637,141	\$2,617,883	\$0	\$72,716,579
Onions	\$0	\$0	\$231,040	\$0	\$0	\$231,040
Dry Peas	\$4,161	\$0	\$21,267	\$63,800	\$0	\$89,227
Grapes	\$69,137	\$84,501	\$107,546	\$88,341	\$53,773	\$403,298
Blueberries	\$159,440	\$8,858	\$8,662,928	\$7,050,809	\$33,030,736	\$48,912,772
Corn	\$217,971	\$0	\$11,579,290	\$9,114,541	\$23,515,718	\$44,427,520
Grasses and Hay	\$1,788,884	\$0	\$926,319	\$582,544	\$204,378	\$3,502,126

⁵ Commodities are reported on an acreage basis rather than a value basis. Apple and potatoes, generate more value per acre, but compose much less acreage than wheat and forage crops.

Milk	\$3,716,621	\$0	\$46,260,827	\$74,595,015	\$239,045,412	\$363,617,875
County Sub Total	\$6,890,568	\$571,695	\$142,365,014	\$95,428,167	\$296,778,190	\$542,033,634

Source: USDA NASS, WSDA, and author's calculations

Thirteen percent of the growth in the region's agricultural production is estimated to be a result of broadband enhancements and the adoption of precision agriculture. Without access to these new technologies agriculture in the region would not have seen the growth or growth rate that has helped to make farms more efficient and profitable. This allows agriculture in the region to remain competitive and on the cutting edge of efficiency.

The impacts of broadband access and subsequent precision ag technology utilization generate more than simply increases in farm output and reduced input costs. Those gains in production efficiency ripple through the economy as increased spending, resulting from increases in farm output, and increased income for farm households.⁶ Table two shows the direct agricultural gains in sales, gross regional product, household income and jobs for the region, all resulting from broadband access and utilization. The direct sales amounted to just over \$54 million. Those direct gains resulted in increased farm-to-business transactions within the region of \$11.3 million (indirect contributions). Increased farm profits improved farmer's take-home pay and household expenditure, consumer-to-business transactions, produced another \$23.1 million (induced contributions). Total sales of \$88.4 million in the region were a result of broadband access and utilization. This occurred in two ways: farm purchases of business inputs (everything from seed and fertilizer to business services including accounting and legal fees), and the personal purchases of both farmers and their employees (eating in local restaurants, attending a local sporting event, buying clothes for their families, etc.).

Table 2: Regional Economic Impacts from Agricultural Productivity Under Broadband Expansion

	Sales	GRP	Income	Jobs
Direct	\$54,038,814	\$33,788,373	\$24,612,575	1,091
Indirect	\$11,281,483	\$4,278,815	\$2,546,159	40
Induced	\$23,116,371	\$12,821,836	\$8,857,807	137
Total	\$88,436,668	\$50,889,024	\$36,016,541	1,267

Source: IMPLAN and author's calculations

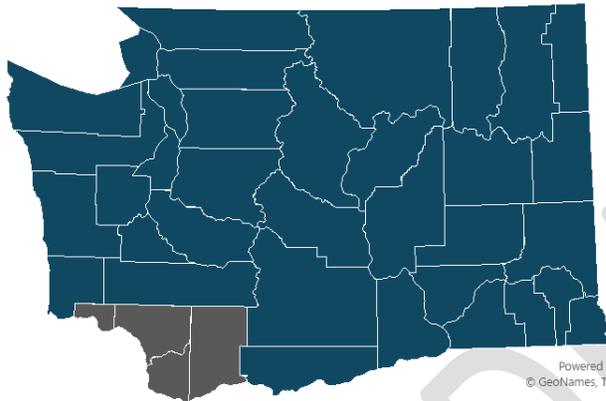
The \$88.4 million in total sales translated to \$50.9 million in total Gross Regional Product (GRP) for 2023. Household incomes attributable to gains in broadband access and precision agricultural utilization amounted to \$36.0 million. The agricultural expenditures and gains from broadband infrastructure supported a total of 1,267 jobs within the 5-county economy. Broadband access and gains from precision agriculture can then claim responsibility for 0.37% of regional employment.

⁶ Farmer household income is a gross measure. Reduced expenditures on fertilizers, for example, mean less farm spending on local vendor purchases that also ripple through the economy.

GRP is the economists’ primary measure of economic activity because it removes the double counting included in the sales figures, though it is larger than the household income measure. As such broadband expansion, access, and utilization in the five-county region is responsible for \$50 million of the 2023 economy.

Region 2:

This Fact Sheet provides the economic overview of broadband availability and the associated agricultural impacts in the four-county region of Cowlitz, Clark, Skamania, and Wahkiakum Counties.



Broadband access in this region has evolved over the years in terms of access, quality, and adoption. The primary crop land in the region is Pasture (30%), Grass Hay (23%), Pasture, Forest (21%), Developed (5%), Grass Seed (4%), and Other (17%).² Total agricultural value of all commodities produced in the region has grown from \$88.7 million to \$100.8 million in this region over the last decade.

Table 1 shows the estimated values of select commodities produced in 2023 by county within the region. Table 1 only lists a set of the key commodities produced and, as such, does not reflect the entire value of agricultural production. Shellfish and Pastureland, for example, are not included.

Table 1: 2023 Region 2 Production Value Estimates by County and Commodity

County	Clark	Cowlitz	Skamania	Wahkiakum	Regional Total
Wheat	\$0	\$73,903	\$0	\$0	\$73,903
Barley	\$51,124	\$61,747	\$0	\$0	\$112,871
Apples	\$137,755	\$52,983	\$10,597	\$0	\$201,334
Pears	\$111,818	\$0	\$614,999	\$0	\$726,817
Grapes	\$610,708	\$7,682	\$1,332,804	\$0	\$1,951,194
Blueberries	\$1,217,948	\$859,207	\$0	\$0	\$2,077,154
Corn	\$181,084	\$45,271	\$0	\$11,737	\$238,091
Grasses and Hay	\$114,724	\$0	\$0	\$0	\$114,724
Milk	\$9,584,439	\$0	\$0	\$1,191,743	\$10,776,182

County Sub Total	\$12,009,600	\$1,100,792	\$1,958,400	\$1,203,480	\$16,272,271
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Source: USDA NASS, WSDA, and author's calculations

Forty-three percent of that growth is estimated to be a result of broadband enhancements and the adoption of precision agriculture. Without access to these new technologies agriculture in the region would not have seen the growth, or growth rate, that has helped to make farms more efficient and profitable. This allows agriculture in the region to remain competitive and on the cutting edge of efficiency.

The impacts of broadband access and subsequent precision ag technology utilization generate more than simply increases in farm output and reduced input costs. Those gains in production efficiency ripple through the economy as increased spending, resulting from increases in farm output, and increased income for farm households.⁷ Table two shows the direct agricultural gains in sales, gross regional product, household income and jobs for the region, all resulting from broadband access and utilization. The direct sales amounted to just under \$5.3 million. Those direct gains resulted in increased farm-to-business transactions within the region of roughly \$1.0 million (indirect contributions). Increased farm profits improved farmer's take-home pay and household expenditures, consumer-to-business transactions, produced another \$2.3 million (induced contributions). Total sales of \$8.5 million in the region were a result of broadband access and utilization. This occurred in two ways: farm purchases of business inputs (everything from seed and fertilizer to business services including accounting and legal fees), and the personal purchases of both farmers and their employees (eating in local restaurants, attending a local sporting event, buying clothes for their families, etc.).

Table 2: Regional Economic Impacts from Agricultural Productivity Under Broadband Expansion

	Sales	GRP	Income	Jobs
Direct	\$5,269,330	\$3,261,802	\$1,864,994	84
Indirect	\$940,809	\$394,345	\$226,515	4
Induced	\$2,339,343	\$1,291,624	\$936,221	14
Total	\$8,549,482	\$4,947,770	\$3,027,731	102

Source: IMPLAN and author's calculations

The \$8.5 million in total sales translated to \$4.9 million in total Gross Regional Product (GRP) for 2023. Household incomes attributable to gains in broadband access and precision agricultural utilization amounted to \$3.0 million. The agricultural expenditures and gains from broadband infrastructure supported a total of 102 jobs within the four-county economy. Broadband access and gains from precision agriculture can then claim responsibility for 0.04% of regional employment.

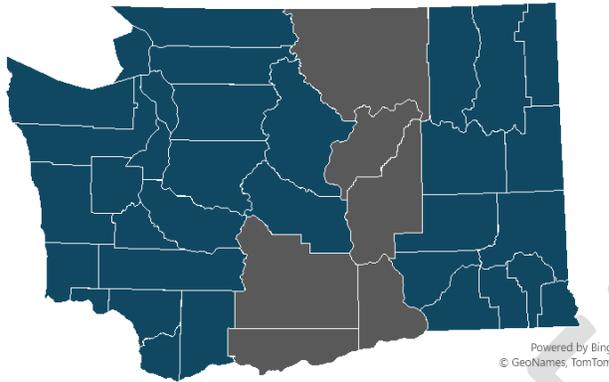
GRP is the economists' primary measure of economic activity because it removes the double counting included in the sales figures, though it is still larger than the household income measure. As such

⁷ Farmer household income is a gross measure. Reduced expenditures on fertilizers, for example, mean less farm spending on local vendor purchases that also ripple through the economy.

broadband expansion, access, and utilization in the four-county region is responsible for \$4.9 million of the 2023 regional economy.

Region 3:

This Fact Sheet provides the economic overview of broadband availability and the associated agricultural impacts in the six-county region of Douglas, Okanogan, Grant, Yakima, Benton, and Klickitat Counties.



Broadband access in this region has evolved over the years in terms of access, quality, and adoption. The primary crop land in the region are Forests (25%), Wheat (13%), Pasture (13%), Fallow (11%), and Conservation (10%), and Other (29%).⁸ Total agricultural value of all commodities produced in the region has grown from \$4.9 billion to \$6.8 billion in this region over the last decade.

Table 1 shows the estimated values of select commodities produced in 2023 by county within the region. Table 1 only lists a set of the key commodities produced and, as such, does not reflect the entire value of agricultural production. Shellfish and Pastureland, for example, are not included.

Table 1: 2023 Region 3 Production Value Estimates by County and Commodity

County	Benton	Douglas	Grant	Klickitat	Okanogan	Yakima	To
Wheat	\$38,076,888	\$42,469,098	\$62,394,407	\$9,875,998	\$1,730,594	\$10,118,364	\$164,665,3
Barley	\$0	\$0	\$351,229	\$719,057	\$502,609	\$664	\$1,573,5
Apples	\$120,419,178	\$102,458,028	\$617,736,393	\$14,824,571	\$199,543,605	\$525,906,704	\$1,580,888,4
Cherries	\$38,658,703	\$25,033,464	\$68,103,649	\$8,176,646	\$35,261,788	\$76,956,672	\$252,190,9
Pears	\$1,852,984	\$3,586,163	\$5,934,341	\$5,870,445	\$26,333,139	\$44,527,525	\$88,104,5
Potatoes	\$247,227,716	\$0	\$405,425,761	\$13,889,927	\$0	\$1,081,770	\$667,625,1
Onions	\$177,308,760	\$0	\$108,704,320	\$765,320	\$0	\$476,520	\$287,254,9
Canola	\$0	\$2,827,476	\$4,267,039	\$151,633	\$352,546	\$0	\$7,598,6
Dry Peas	\$2,406,819	\$214,053	\$3,533,484	\$45,307	\$30,051	\$0	\$6,229,7
Grapes	\$95,372,768	\$1,812,921	\$50,788,003	\$48,385,034	\$226,615	\$83,267,484	\$279,852,8
Hops	\$68,475,497	\$0	\$10,446	\$0	\$0	\$400,417,125	\$468,903,0

⁸ Commodities are reported on an acreage basis rather than a value basis. Apple and potatoes, generate more value per acre, but compose much less acreage than wheat and forage crops.

Blueberries	\$18,455,226	\$13,287	\$1,492,539	\$0	\$4,429	\$1,806,991	\$21,772,4
Mint	\$3,364,449	\$0	\$3,865,881	\$0	\$0	\$15,695,370	\$22,925,7
Corn	\$81,631,816	\$910,448	\$155,011,312	\$1,960,062	\$2,432,892	\$80,658,452	\$322,604,9
Grasses/Hay	\$21,951,092	\$2,997,409	\$341,035,267	\$15,889,853	\$18,201,415	\$82,077,232	\$482,152,2
Milk	\$40,887,885	\$0	\$214,402,596	\$7,246,402	\$186,841	\$465,405,833	\$728,129,5
County Subtotal	\$956,089,780	\$182,322,345	\$2,043,056,668	\$127,800,255	\$284,806,523	\$1,788,396,707	\$5,382,472,2

Source: USDA NASS, WSDA, and author's calculations

sixteen percent of the past decade's growth is estimated to be a result of broadband enhancements and the adoption of precision agriculture. Without access to these new technologies agriculture in the region would not have seen the growth, or growth rate, that has helped to make farms more efficient and profitable. This allows agriculture in the region to remain competitive and on the cutting edge of efficiency.

The impacts of broadband access and subsequent precision ag technology utilization generate more than simply increases in farm output and reduced input costs. Those gains in production efficiency ripple through the economy as increased spending, resulting from increases in farm output and increased income for farm households.⁹ Table two shows the direct agricultural gains in sales, gross regional product, household income and jobs for the region, all resulting from broadband access and utilization. The direct sales amounted to just over \$311.5 million. Those direct gains resulted in increased farm-to-business transactions within the region of roughly \$42.8 million (indirect contributions). Increased farm profits improved farmer's take-home pay and household expenditures. associated consumer-to-business transactions, produced another \$184.7 million (induced contributions). Total sales of \$539.1 million in the region were a result of broadband access and utilization. This occurred in two ways: farm purchases of business inputs (everything from seed and fertilizer to business services including accounting and legal fees), and the personal purchases of both farmers and their employees (eating in local restaurants, attending a local sporting event, buying clothes for their families, etc.).

Table 2: Regional Economic Impacts from Agricultural Productivity Under Broadband Expansion

	Sales	GRP	Income	Jobs
Direct	\$311,563,459	\$189,339,940	\$115,527,216	2,417
Indirect	\$42,852,832	\$19,636,536	\$12,557,393	208
Induced	\$184,720,920	\$104,088,207	\$77,827,335	1,304
Total	\$539,137,212	\$313,064,683	\$205,911,944	3,929

Source: IMPLAN and author's calculations

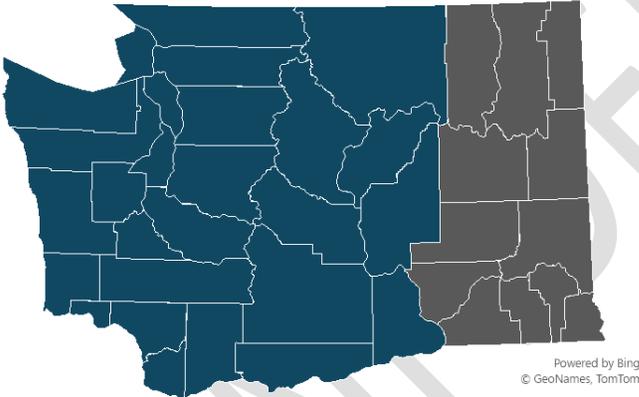
⁹ Farmer household income is a gross measure. Reduced expenditures on fertilizers, for example, mean less farm spending on local vendor purchases that also ripple through the economy.

The \$539.1 million in total sales translated to \$313.0 million in total Gross Regional Product (GRP) for 2023. Household incomes attributable to gains in broadband access and precision agricultural utilization amounted to \$205.9 million. The agricultural expenditures and gains from broadband infrastructure supported a total of 3,929 jobs within the six-county economy. Broadband access and gains from precision agriculture can then claim responsibility for 1.14% of regional employment.

GRP is the economists’ primary measure of economic activity because it removes the double counting included in the sales figures, though it is still larger than the household income measure. As such broadband expansion, access, and utilization in the six-county region is responsible for \$313.0 million of the 2023 regional economy.

Region 4:

This Fact Sheet provides the economic overview of broadband availability and the associated agricultural impacts in the 12-county region of Ferry, Stevens, Pend Oreille, Lincoln, Spokane, Whitman, Adams, Columbia, Garfield, Asotin, Walla Walla, and Franklin counties.



Broadband access in this region has evolved over the years in terms of access, quality, and adoption. The primary crop land in the region is Wheat (30%), Wheat Fallow (16%), Pasture, Forest (14%), CRP/Conservation (12%), Pasture (9%), and Other (18%).¹⁰ Total agricultural value of all commodities produced in the region has grown from \$2.4 billion to \$3.4 billion in this region over the last decade.

Table 1 shows the estimated values of select commodities produced in 2023 by county within the region. Table 1 only lists a set of the key commodities produced and, as such, does not reflect the entire value of all agricultural production. Shellfish and Pastureland, for example, are not included.

Table 1: 2023 Region 4 Production Value Estimates by County and Commodity

County	Adams	Asotin	Columbia	Ferry	Franklin	Garfield
Wheat	\$94,185,997	\$6,517,546	\$43,835,334	\$106,581	\$28,411,905	\$29,125,320
Barley	\$536,471	\$723,704	\$2,854,169	\$0	\$0	\$597,554
Apples	\$44,865,786	\$105,965	\$1,525,903	\$275,510	\$156,288,494	\$10,597
Cherries	\$1,690,943	\$37,577	\$0	\$30,061	\$35,825,435	\$0
Pears	\$0	\$0	\$367,402	\$71,883	\$838,635	\$0

¹⁰ Commodities are reported on an acreage basis rather than a value basis. Apple and potatoes, generate more value per acre, but compose much less acreage than wheat and forage crops.

Potatoes	\$202,940,052	\$0	\$0	\$0	\$294,623,665	\$0
Onions	\$41,442,800	\$0	\$0	\$0	\$92,416,000	\$0
Canola	\$1,182,735	\$873,783	\$1,896,830	\$0	\$150,211	\$3,111,787
Garbanzos	\$0	\$0	\$3,340,033	\$0	\$0	\$160,453
Dry Peas	\$4,396,629	\$80,443	\$7,812,223	\$0	\$1,007,850	\$275,541
Lentils	\$0	\$0	\$0	\$0	\$0	\$0
Grapes	\$261,183	\$30,727	\$0	\$0	\$12,468,608	\$0
Hops	\$0	\$0	\$0	\$0	\$0	\$0
Blueberries	\$0	\$0	\$0	\$0	\$7,506,986	\$0
Mint	\$8,473,127	\$0	\$0	\$0	\$930,076	\$0
Corn	\$29,602,998	\$0	\$221,324	\$21,797	\$76,745,927	\$0
Grasses/ Hay	\$56,085,925	\$2,370,582	\$3,645,652	\$2,950,454	\$196,969,605	\$1,639,635
Milk	\$27,258,590	\$0	\$0	\$0	\$60,056,764	\$0
County Sub Total	\$512,923,237	\$10,740,328	\$65,498,872	\$3,456,287	\$964,240,161	\$34,920,886

Table 1 (Continued): 2023 Region 4 Production Value Estimates by County and Commodity

County	Lincoln	Pend Oreille	Spokane	Stevens	Walla Walla	Whitman	Regional Total
Wheat	\$121,202,934	\$18,601	\$53,143,916	\$1,179,432	\$85,523,563	\$226,279,723	\$689,530,854
Barley	\$4,762,225	\$61,083	\$3,331,036	\$768,896	\$1,839,138	\$13,116,887	\$28,591,165
Apples	\$31,790	\$10,597	\$1,409,341	\$826,531	\$115,544,765	\$127,159	\$321,022,438
Cherries	\$0	\$0	\$398,311	\$97,699	\$6,478,189	\$0	\$44,558,214
Pears	\$0	\$0	\$23,961	\$39,935	\$0	\$0	\$1,341,816
Potatoes	\$24,173,954	\$0	\$0	\$108,177	\$116,809,525	\$0	\$638,655,373
Onions	\$2,512,560	\$0	\$0	\$0	\$28,273,520	\$0	\$164,644,880
Canola	\$13,772,986	\$0	\$10,272,167	\$356,337	\$1,386,018	\$22,092,408	\$55,095,262
Garbanzos	\$1,259,062	\$0	\$4,877,977	\$0	\$5,274,742	\$36,577,733	\$51,490,000
Dry Peas	\$1,193,239	\$0	\$4,862,182	\$29,588	\$5,699,437	\$7,453,928	\$32,811,059
Lentils	\$0	\$0	\$5,883,435	\$0	\$0	\$10,387,442	\$16,270,877
Grapes	\$65,296	\$0	\$42,250	\$99,864	\$11,706,240	\$15,364	\$24,689,533

Hops	\$0	\$0	\$10,446	\$10,446	\$41,785	\$0	\$62,678
Blueberries	\$141,725	\$0	\$141,725	\$13,287	\$1,248,950	\$0	\$9,052,672
Mint	\$0	\$0	\$0	\$0	\$1,178,096	\$0	\$10,581,300
Corn	\$1,567,715	\$0	\$409,115	\$482,890	\$38,731,770	\$962,426	\$148,745,962
Grasses/ Hay	\$31,172,121	\$1,494,708	\$39,470,426	\$28,195,417	\$47,525,860	\$17,888,460	\$429,408,846
Milk	\$373,682	\$0	\$5,726,425	\$5,771,873	\$0	\$3,716,621	\$102,903,955
County Sub Total	\$202,229,288	\$1,584,989	\$130,002,713	\$37,980,372	\$467,261,598	\$338,618,151	\$2,769,456,882

Source: USDA NASS, WSDA, and author's calculations

sixteen percent of the past decade's growth is estimated to be a result of broadband enhancements and the adoption of precision agriculture. Without access to these new technologies agriculture in the region would not have seen the growth, or growth rate, that has helped to make farms more efficient and profitable. This allows agriculture in the region to remain competitive and on the cutting edge of efficiency.

The impacts of broadband access and subsequent precision ag technology utilization generate more than simply increases in farm output and reduced input costs. Those gains in production efficiency ripple through the economy as increased spending, resulting from increases in farm output and increased income for farm households.¹¹ Table two shows the direct agricultural gains in sales, gross regional product, household income and jobs for the region, all resulting from broadband access and utilization. The direct sales amounted to just over \$154.3 million. Those direct gains resulted in increased farm-to-business transactions within the region of roughly \$25.2 million (indirect contributions). Increased farm profits improved farmer's take-home pay and household expenditures. associated consumer-to-business transactions, produced another \$91.4 million (induced contributions). Total sales of \$270.9 million in the region were a result of broadband access and utilization. This occurred in two ways: farm purchases of business inputs (everything from seed and fertilizer to business services including accounting and legal fees), and the personal purchases of both farmers and their employees (eating in local restaurants, attending a local sporting event, buying clothes for their families, etc.).

Table 1: Regional Economic Impacts from Agricultural Productivity Under Broadband Expansion

	Sales	GDP	Income	Jobs
Direct	\$154,309,716	\$94,464,417	\$61,339,057	1,943
Indirect	\$25,184,096	\$11,123,607	\$7,228,972	124
Induced	\$91,390,771	\$49,726,486	\$35,774,035	599

¹¹ Farmer household income is a gross measure. Reduced expenditures on fertilizers, for example, mean less farm spending on local vendor purchases that also ripple through the economy.

Total	\$270,884,583	\$155,314,510	\$104,342,064	2,666
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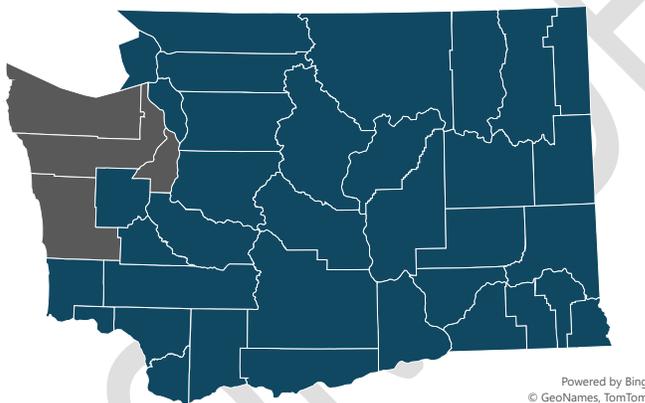
Source: IMPLAN and author's calculations

The \$270.9 million in total sales translated to \$155.3 million in total Gross Regional Product (GRP) for 2023. Household incomes attributable to gains in broadband access and precision agricultural utilization amounted to \$104.3 million. The agricultural expenditures and gains from broadband infrastructure supported a total of 2,666 jobs within the 12-county economy. Broadband access and gains from precision agriculture can then claim responsibility for 0.77% of regional employment.

GRP is the economists' primary measure of economic activity because it removes the double counting included in the sales figures, though it is still larger than the household income measure. As such broadband expansion, access, and utilization in the 12-county region is responsible for \$155.3 million of the 2023 regional economy.

Region 5:

This Fact Sheet provides the economic overview of broadband availability and the associated agricultural impacts in the 5-county region of Clallam, Grays Harbor, Jefferson, Kitsap, and Mason counties.



Broadband access in this region has evolved over the years in terms of access, quality, and adoption. The primary crop in the region is Shellfish (76%), Pasture (10%), Grass Hay (9%), Fallow (1%), Corn (1%), and Other (4%).¹² Total agricultural value of all commodities produced in the region has grown from \$95.8 million to \$180.1 million in this region over the last decade.

Table 1 shows the estimated values of select commodities produced in 2023 by county within the region. Table 1 only lists a set of the key commodities produced and, as such, does not reflect the entire value of all agricultural production. Shellfish and Pasture, for example, are the largest commodity types in the region and are not included.

Table 1: 2023 Region 5 Production Value Estimates by County and Commodity

County	Clallam	Grays Harbor	Jefferson	Kitsap	Mason	Regional Total
Wheat	\$19,607	\$152,330	\$0	\$0	\$0	\$171,937
Barley	\$293,413	\$51,124	\$0	\$0	\$0	\$344,537
Apples	\$84,772	\$63,579	\$243,721	\$0	\$0	\$392,072

¹² Commodities are reported on an acreage basis rather than a value basis. Apple and potatoes, generate more value per acre, but compose much less acreage than wheat and forage crops.

Cherries	\$7,515	\$0	\$0	\$0	\$0	\$7,515
Pears	\$15,974	\$0	\$15,974	\$0	\$0	\$31,948
Grapes	\$7,682	\$15,364	\$61,455	\$72,978	\$53,773	\$211,251
Blueberries	\$35,431	\$4,429	\$22,145	\$8,858	\$4,429	\$75,291
Corn	\$251,505	\$2,602,238	\$0	\$8,384	\$10,060	\$2,872,187
Grasses and Hay	\$279,682	\$52,060	\$0	\$0	\$0	\$331,742
Milk	\$4,534,682	\$8,554,289	\$0	\$560,523	\$0	\$13,649,494
County Sub Total	\$5,530,263	\$11,495,414	\$343,294	\$650,742	\$68,262	\$18,087,975

Source: USDA NASS, WSDA, and author's calculations

Ten percent of the past decade's growth is estimated to be a result of broadband enhancements and the adoption of precision agriculture. Without access to these new technologies agriculture in the region would not have seen the growth, or growth rate, that has helped to make farms more efficient and profitable. This allows agriculture in the region to remain competitive and on the cutting edge of efficiency.

The impacts of broadband access and subsequent precision ag technology utilization generate more than simply increases in farm output and reduced input costs. Those gains in production efficiency ripple through the economy as increased spending, resulting from increases in farm output and increased income for farm households.¹³ Table two shows the direct agricultural gains in sales, gross regional product, household income and jobs for the region, all resulting from broadband access and utilization. The direct sales amounted to just over \$8.9 million. Those direct gains resulted in increased farm-to-business transactions within the region of roughly \$1.6 million (indirect contributions). Increased farm profits improved farmer's take-home pay and household expenditures. associated consumer-to-business transactions, produced another \$3.1 million (induced contributions). Total sales of \$13.6 million in the region were a result of broadband access and utilization. This occurred in two ways: farm purchases of business inputs (everything from seed and fertilizer to business services including accounting and legal fees), and the personal purchases of both farmers and their employees (eating in local restaurants, attending a local sporting event, buying clothes for their families, etc.).

Table 2: Regional Economic Impacts from Agricultural Productivity Under Broadband Expansion

	Sales	GDP	Income	Jobs
Direct	\$8,902,591	\$5,327,421	\$4,145,888	315
Indirect	\$1,573,121	\$609,454	\$376,663	7
Induced	\$3,120,303	\$1,758,618	\$1,178,682	22

¹³ Farmer household income is a gross measure. Reduced expenditures on fertilizers, for example, mean less farm spending on local vendor purchases that also ripple through the economy.

Total	\$13,596,014	\$7,695,493	\$5,701,233	344
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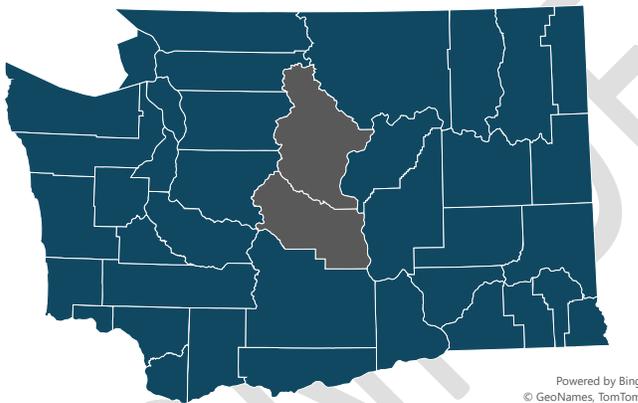
Source: IMPLAN and author's calculations

The \$13.6 million in total sales translated to \$7.7 million in total Gross Regional Product (GRP) for 2023. Household incomes attributable to gains in broadband access and precision agricultural utilization amounted to \$5.7 million. The agricultural expenditures and gains from broadband infrastructure supported a total of 344 jobs within the 5-county economy. Broadband access and gains from precision agriculture can then claim responsibility for 0.1% of regional employment.

GRP is the economists' primary measure of economic activity because it removes the double counting included in the sales figures, though it is still larger than the household income measure. As such broadband expansion, access, and utilization in the 5-county region is responsible for \$7.7 million of the 2023 regional economy.

Region 6:

This Fact Sheet provides the economic overview of broadband availability and the associated agricultural impacts in the 2-county region of Chelan and Kittitas counties.



Broadband access in this region has evolved over the years in terms of access, quality, and adoption. The primary crop in the region is Pasture/forest (84%), Timothy Hay (4%), Alfalfa Hay (2%), Other Grasses (2%), and Other (9%).¹⁴ Total agricultural value of all commodities produced in the region has grown from \$275.4 million to \$345.4 million in this region over the last decade.

Table 1 shows the estimated values of select commodities produced in 2023 by county within the region. Table 1 only lists a set of the key commodities produced and, as such, does not reflect the entire value of all agricultural production. Shellfish and Pasture, for example, are not included.

Table 1: 2023 Region 6 Production Value Estimates by County and Commodity

County	Chelan	Kittitas	Regional Total
Wheat	\$26,645	\$607,813	\$634,458
Apple	\$57,390,907	\$29,002,753	\$86,393,660
Cherry	\$46,594,860	\$1,818,703	\$48,413,563
Pear	\$58,233,217	\$830,648	\$59,063,865

¹⁴ Commodities are reported on an acreage basis rather than a value basis. Apple and potatoes, generate more value per acre, but compose much less acreage than wheat and forage crops.

Potato	\$0	\$1,197,159	\$1,197,159
Canola	\$0	\$99,035	\$99,035
Grapes	\$1,724,579	\$301,925	\$2,026,504
Hops	\$41,785	\$0	\$41,785
Blueberry	\$128,438	\$146,154	\$274,592
Corn	\$5,030	\$140,843	\$145,873
Grasses and Hay	\$289,224	\$67,647,514	\$67,936,738
Milk	\$373,682	\$186,841	\$560,523
County Sub Total	\$164,808,367	\$101,979,387	\$266,787,755

Source: USDA NASS, WSDA, and author's calculations

23-percent of the past decade's growth is estimated to be a result of broadband enhancements and the adoption of precision agriculture. Without access to these new technologies agriculture in the region would not have seen the growth, or growth rate, that has helped to make farms more efficient and profitable. This allows agriculture in the region to remain competitive and on the cutting edge of efficiency.

The impacts of broadband access and subsequent precision ag technology utilization generate more than simply increases in farm output and reduced input costs. Those gains in production efficiency ripple through the economy as increased spending, resulting from increases in farm output and increased income for farm households.¹⁵ Table two shows the direct agricultural gains in sales, gross regional product, household income and jobs for the region, all resulting from broadband access and utilization. The direct sales amounted to just over \$16.5 million. Those direct gains resulted in increased farm-to-business transactions within the region of roughly \$1.8 million (indirect contributions). Increased farm profits improved farmer's take-home pay and household expenditures. associated consumer-to-business transactions, produced another \$5.9 million (induced contributions). Total sales of \$24.3 million in the region were a result of broadband access and utilization. This occurred in two ways: farm purchases of business inputs (everything from seed and fertilizer to business services including accounting and legal fees), and the personal purchases of both farmers and their employees (eating in local restaurants, attending a local sporting event, buying clothes for their families, etc.).

Table 2: Regional Economic Impacts from Agricultural Productivity Under Broadband Expansion

	Sales	GDP	Income	Jobs
Direct	\$16,556,315	\$10,044,040	\$6,448,358	210
Indirect	\$1,827,281	\$879,243	\$551,510	10
Induced	\$5,894,960	\$3,403,016	\$2,466,223	45

¹⁵ Farmer household income is a gross measure. Reduced expenditures on fertilizers, for example, mean less farm spending on local vendor purchases that also ripple through the economy.

Total	\$24,278,556	\$14,326,299	\$9,466,090	265
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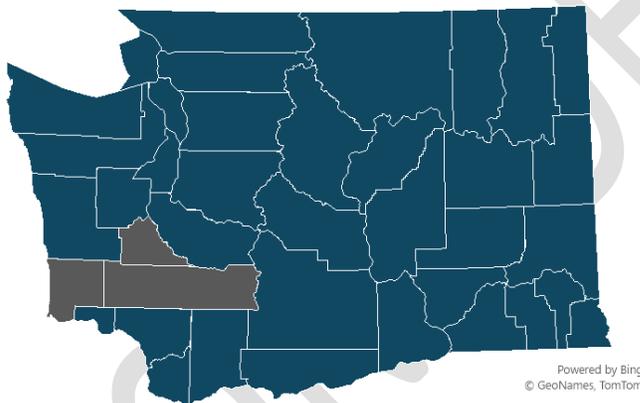
Source: IMPLAN and author's calculations

The \$24.3 million in total sales translated to \$14.3 million in total Gross Regional Product (GRP) for 2023. Household incomes attributable to gains in broadband access and precision agricultural utilization amounted to \$9.5 million. The agricultural expenditures and gains from broadband infrastructure supported a total of 265 jobs within the two-county economy. Broadband access and gains from precision agriculture can then claim responsibility for 0.08% of regional employment.

GRP is the economists' primary measure of economic activity because it removes the double counting included in the sales figures, though it is still larger than the household income measure. As such broadband expansion, access, and utilization in the two-county region is responsible for \$14.3 million of the 2023 regional economy.

Region 7:

This Fact Sheet provides the economic overview of broadband availability and the associated agricultural impacts in the 3-county region of Lewis, Pacific, and Thurston counties.



Broadband access in this region has evolved over the years in terms of access, quality, and adoption. The primary crop in the region is Shellfish (39%), Pasture (25%), Grass Hay (22%), Fallow (3%), Christmas Trees (3%), and Other (8%).¹⁶ Total agricultural value of all commodities produced in the region has grown from \$291.5 million to \$451.5 million in this region over the last decade.

Table 1 shows the estimated values of select commodities produced in 2023 by county within the region. Table 1 only lists a set of the key commodities produced and, as such, does not reflect the entire value of all agricultural production. Shellfish and Pasture, for example, are two of the largest areas of production and are not included.

Table 1: 2023 Region 6 Production Value Estimates by County and Commodity

County	Chelan	Kittitas	Regional Total
Wheat	\$26,645	\$607,813	\$634,458
Apple	\$57,390,907	\$29,002,753	\$86,393,660
Cherry	\$46,594,860	\$1,818,703	\$48,413,563

¹⁶ Commodities are reported on an acreage basis rather than a value basis. Apple and potatoes, generate more value per acre, but compose much less acreage than wheat and forage crops.

Pear	\$58,233,217	\$830,648	\$59,063,865
Potato	\$0	\$1,197,159	\$1,197,159
Canola	\$0	\$99,035	\$99,035
Grapes	\$1,724,579	\$301,925	\$2,026,504
Hops	\$41,785	\$0	\$41,785
Blueberry	\$128,438	\$146,154	\$274,592
Corn	\$5,030	\$140,843	\$145,873
Grasses and Hay	\$289,224	\$67,647,514	\$67,936,738
Milk	\$373,682	\$186,841	\$560,523
County Sub Total	\$164,808,367	\$101,979,387	\$266,787,755

Source: USDA NASS, WSDA, and author's calculations

13-percent of the past decade's growth is estimated to be a result of broadband enhancements and the adoption of precision agriculture. Without access to these new technologies agriculture in the region would not have seen the growth, or growth rate, that has helped to make farms more efficient and profitable. This allows agriculture in the region to remain competitive and on the cutting edge of efficiency.

The impacts of broadband access and subsequent precision ag technology utilization generate more than simply increases in farm output and reduced input costs. Those gains in production efficiency ripple through the economy as increased spending, resulting from increases in farm output and increased income for farm households.¹⁷ Table two shows the direct agricultural gains in sales, gross regional product, household income and jobs for the region, all resulting from broadband access and utilization. The direct sales amounted to just over \$21million. Those direct gains resulted in increased farm-to-business transactions within the region of roughly \$4.7 million (indirect contributions). Increased farm profits improved farmer's take-home pay and household expenditures. associated consumer-to-business transactions, produced another \$9.3 million (induced contributions). Total sales of nearly \$35 million in the region were a result of broadband access and utilization. This occurred in two ways: farm purchases of business inputs (everything from seed and fertilizer to business services including accounting and legal fees), and the personal purchases of both farmers and their employees (eating in local restaurants, attending a local sporting event, buying clothes for their families, etc.).

Table 2: Regional Economic Impacts from Agricultural Productivity Under Broadband Expansion

	Sales	GDP	Income	Jobs
Direct	\$21,003,986	\$13,007,574	\$8,947,643	494
Indirect	\$4,652,570	\$1,842,326	\$1,138,329	18

¹⁷ Farmer household income is a gross measure. Reduced expenditures on fertilizers, for example, mean less farm spending on local vendor purchases that also ripple through the economy.

Induced	\$9,325,866	\$5,382,107	\$3,733,844	61
Total	\$34,982,422	\$20,232,007	\$13,819,816	573

Source: IMPLAN and author's calculations

The \$35 million in total sales translated to \$20.2 million in total Gross Regional Product (GRP) for 2023. Household incomes attributable to gains in broadband access and precision agricultural utilization amounted to \$13.8 million. The agricultural expenditures and gains from broadband infrastructure supported a total of 573 jobs within the two-county economy. Broadband access and gains from precision agriculture can then claim responsibility for 0.17% of regional employment.

GRP is the economists' primary measure of economic activity because it removes the double counting included in the sales figures, though it is still larger than the household income measure. As such broadband expansion, access, and utilization in the two-county region is responsible for \$13.8 million of the 2023 regional economy.

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6. Conclusions

Broadband access and utilization has enhanced the state's agricultural base and directly contributed to more than \$383 million in agricultural GDP in the 2023 analysis year. While this analysis is focused on the economic gains to the state, and various agricultural sub-regions within the state, it is not focused on the initial buildout and continued operating expenses of the broadband infrastructure. Reads are cautioned not to confuse the activity discussed within this report with a benefit-cost assessment or a welfare analysis of the improved wellbeing of citizens within the state.

Nonetheless, the stated direct effects of \$383 million ultimately contributed a total of \$676 million to state GDP, supporting nearly 8,294 jobs at an average annual income of \$48,847. While this is lower than the average income in the state it is slightly higher than the average agricultural wage and salary in the state.

Regional utilization and associated impacts vary widely across the state. While a formal analysis of utilization and farm efficiencies were not measured in this study, conversations with growers clearly indicated that the larger farms are more likely to invest in the necessary equipment and infrastructure that take advantage of broadband infrastructure. More research on this is currently under way in conjunction with the Washington State Department of Agriculture in their Competitive Analysis that is scheduled to be completed in July of 2025. This research has been a catalyst and jumping off point for that research and may help to refine the impacts of broadband utilization for a future analysis.

While \$676 million in contributions and 8,294 jobs supported is not a trivial amount, it still represents only 0.1% of the state's overall GDP. Such marginal gains will grow over time as access and speed increase and the technology to take advantage of the infrastructure is more widely adopted.

Appendix A

County level estimates from reductions in agricultural costs and increases in agricultural output as a result of broadband access and utilization

County	Region	Net reduction in Ag Costs	Net increase in ag output
Adams	4	\$28,001,760	\$5,616,180
Asotin	4	\$1,199,040	\$209,920
Benton	3	\$59,018,400	\$12,141,830
Chelan	6	\$14,874,240	\$2,698,270
Clallam	5	\$1,584,780	\$170,060
Clark	2	\$4,353,480	\$589,690
Columbia	4	\$4,631,820	\$948,720
Cowlitz	2	\$1,339,020	\$307,760
Douglas	3	\$15,565,800	\$2,547,670
Ferry	4	\$331,860	\$39,970
Franklin	4	\$51,377,640	\$10,060,250
Garfield	4	\$2,782,620	\$544,430
Grant	3	\$138,393,960	\$26,054,170
Grays Harbor	5	\$2,541,240	\$499,280
Island	1	\$1,424,580	\$234,650
Jefferson	5	\$981,060	\$162,380
King	0	\$8,260,560	\$1,026,900
Kitsap	5	\$1,546,800	\$135,720
Kittitas	6	\$4,147,020	\$755,680
Klickitat	3	\$7,906,800	\$1,307,680
Lewis	7	\$10,653,120	\$1,975,920
Lincoln	4	\$11,257,140	\$2,088,810
Mason	5	\$3,656,280	\$833,230
Okanogan	3	\$19,396,800	\$3,636,770
Pacific	7	\$2,892,360	\$633,380
Pend Oreille	4	\$369,720	\$72,450
Pierce	0	\$6,836,640	\$1,047,020
San Juan	1	\$747,180	\$106,430
Skagit	1	\$18,793,440	\$3,669,420
Skamania	2	\$538,800	\$79,590
Snohomish	1	\$15,744,120	\$2,806,780
Spokane	4	\$12,117,540	\$2,050,010
Stevens	4	\$2,133,660	\$330,950
Thurston	7	\$10,392,660	\$1,905,440
Wahkiakum	2	\$297,420	\$31,390
Walla Walla	4	\$37,414,080	\$7,785,620
Whatcom	1	\$24,436,440	\$5,102,660
Whitman	4	\$22,459,860	\$4,653,580
Yakima	3	\$112,811,400	\$22,655,100

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