

University of Idaho

THE UNIVERSITY OF IDAHO COLLEGE
OF AGRICULTURAL AND LIFE SCIENCES

The Economic Impact of the Idaho Agricultural Experiment Station

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 Emsi

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Executive Summary

IN 2013, an estimated 16% of Idaho's Gross State Product (GSP), or \$10.1 billion, stemmed from the work of its agribusiness economy.¹ This represents billions of dollars in economic activity every year, with the Crop and Animal Production sector alone generating almost \$3.0 billion in GSP in 2016, and \$8.8 billion in cash receipts in 2014.² A major part of this work is directly supported and enabled by the research and development at the Idaho Agricultural Experiment Station (IAES) at the University of Idaho in the College of Agricultural and Life Sciences. For 125 years, IAES has worked to improve the quality of life for Idahoans, impacting citizens and the state economy by working with producers, businesses, and communities to find solutions to critical issues. Operating at Research and Extension Centers strategically located throughout Idaho, IAES focuses on improving Idaho farming practices, developing new and valuable crop varieties, and protecting crops from pests and disease. This research represents a multi-million-dollar annual investment in Idaho's economy, including a significant investment from state sources.

Given the variety of subjects researched at IAES facilities, calculating the total value of their work cannot be fully quantified. This report instead focuses on capturing the spending impacts of IAES research activity and a few commodity-specific impacts. We highlight resulting benefits to illustrate the far reach of IAES research. These activities are just a few notable examples demonstrating how IAES boosts the state economy, contributes to the state's agricultural sector, and improves the well-being of citizens. The true economic impact of IAES naturally extends above and beyond all that is captured in this analysis, yet this analysis demonstrates a solid return on the state's investment.

The Idaho Agricultural Experiment Station (IAES) provides significant value to Idaho's

1 "Contribution of Agribusiness to the Idaho Economy, 2013." Garth Taylor, Ben Eborn, and Philip Watson. University of Idaho, 2015.

2 Emsi data - Idaho sales for North American Industry Classification System (NAICS) 11: Crop and Animal Production, 2016.

economy in three main ways: the economic impact of IAES research spending, the further external research funding research attracted to the IAES, and the value of the intellectual property created by IAES research.

- **IAES research spending** amounted to \$8.1 million in FY 2016-17, creating an impact of \$5.1 million in added income. This can also be stated in terms of a sales impact, where IAES research spending created a total of \$11.5 million in additional sales. In other words, for every research dollar spent, \$1.41 in sales were created throughout Idaho.
- **New grant funding** has averaged \$1.7 million per year at the Aberdeen Center, \$1.4 million at the Kimberly Center, and over \$700,000 at the Parma Center for the last three years. These represent just three of nine Research and Extension Centers. Much of this funding can be attributed to the high-profile success of prior IAES work, making potential partners interested in investing in its research. This in turn accelerates the virtuous circle of more research, leading to more high-profile success and further funding.
- **Intellectual property** stemming from IAES research creates impacts through better quality and more effi-

cient potato and wheat varieties, the early detection and therefore prevention of disease epidemics like stripe rust in wheat, collaboration in new malting and food barley varieties, pest mitigation for barley production, and improved irrigation and tillage practices for crops like onions and sugarbeets.

- Not all intellectual property can be directly quantified, but what can be yields an estimated **annual impact** of \$11.0 million in additional income and \$37.6 million in additional sales if fully implemented. This excludes the **one-time economic impact** stemming from IAES early detection and warning of stripe rust in 2011, an estimated \$178.5 million in income and \$230.0 million in sales in savings to the Idaho wheat industry and state economy.
- **The total annual economic impact** of IAES research spending and the annual impacts stemming from intellectual property sums to \$16.1 million in additional income and \$49.1 million in additional sales. Again, this is a snapshot of the research and outreach activities taking place, yet it demonstrates a strong return on the state's investment in IAES. The reach of IAES extends beyond this analysis's scope and continues to serve the state and society as a whole.



Introduction

As Idaho's land-grant university, the University of Idaho has always been committed to reaching out to all of Idaho's citizens. This includes the world-class education the University's students receive, but it also includes the research of the Idaho Agricultural Experiment Station (IAES). For 125 years, IAES has worked to improve the quality of life for Idahoans, impacting citizens and the state economy by working with producers, businesses, and communities to find solutions to critical issues.

Operating from nine Research and Extension Centers, IAES conducts scientific research across 4,000 acres of dedicated land and is based at the University of Idaho College of Agricultural and Life Sciences (CALs). IAES also partners with industry and other government agencies, such as the US Department of Agriculture (USDA), to create research synergy that improves research efficiency. Furthermore, the type of research IAES conducts mitigates risk for farmers. For example, IAES tests new crop varieties and irrigation methods for farmers, practices which otherwise may not be profitable for farmers to implement without testing.

Given the variety of subjects researched at IAES facilities, the full impact of IAES cannot be completely quantified.

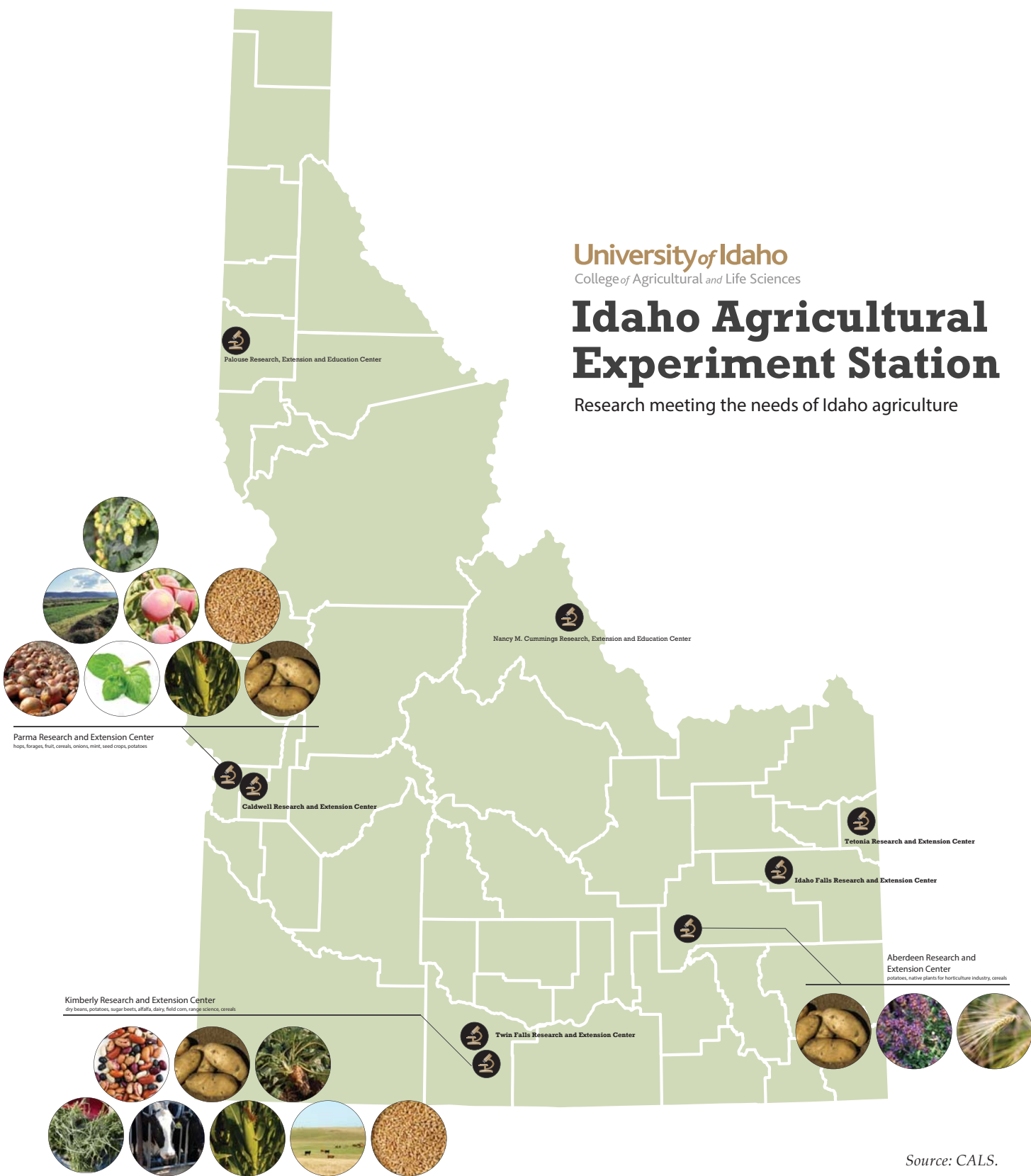
To provide some sense of its value, this report quantifies and provides notable examples of the actual and potential impact of IAES at three Research and Extension Centers:

- Parma Research and Extension Center, in Canyon County;
- Aberdeen Research and Extension Center, in Bingham County; and
- Kimberly Research and Extension Center, in Twin Falls County.

These research stations are displayed in Figure 1, on the next page.



FIGURE 1: Map of Idaho Research and Extension Centers



Source: CALS.

Demonstrating the Value of IAES

At the Research and Extension Centers, IAES faculty and staff are involved in a wide range of research on critical issues to Idaho's agricultural producers. Taken as a whole, IAES research provides economic value to Idaho in three ways.

- First, IAES research involves the spending of money to employ faculty and staff and to purchase equipment and other supplies, spending which creates a ripple or "multiplier" effect in the state economy.
- Second, the high-profile success of this research attracts new grant money from public and private sources who see value in IAES research, increasing IAES' ability to produce intellectual property.
- Third, IAES research creates new intellectual property, such as improved potato breeds and more efficient irrigation techniques, improving the quality of crops, efficiency of farmers, and economic sustainability of farmers.

This analysis starts by taking a narrow focus on the spending impacts of IAES research and the amount of grant funding attracted through public and private sources to support IAES. We then highlight the application of IAES work and the resulting benefits to illustrate the broader effects of IAES research. Where possible, we capture the impacts stemming from intellectual property created through IAES research. These activities are just a few notable examples demonstrating how IAES boosts the state economy, contributes to the state's agricultural sector, and improves the well-being of citizens. The true economic impact of IAES naturally extends above and beyond all that is captured in this analysis.



Spending Impacts of IAES Research on the Idaho Economy

In Fiscal Year (FY) 2016-17, IAES spent more than \$8.1 million on research and development. This included employing over 100 full- and part-time faculty, staff, and students. This spending added nearly \$11.5 million in sales to the Idaho economy in FY 2016-17. In other words, every dollar IAES spends on research creates \$1.41 in sales. The impact can also be stated as \$5.1 million created in additional income, or value added, and an additional 137 jobs across the state.

The Idaho economy is impacted by IAES through research expenditures and the spending of employees. IAES is an employer and buyer of goods and services for various research activities. Faculty and staff payroll and benefits are part of the state's overall income, and the spending by employees for groceries, apparel, and other household spending helps support businesses in the state economy. These expenses create a ripple effect that generates additional jobs and income throughout the economy. In this section, we estimate the economic impact of this spending on the Idaho economy.³

IAES employed 62 full-time and 46 part-time workers in FY 2016-17 at the Parma, Kimberly, and Aberdeen Centers. This includes faculty, technicians, postdoctoral researchers, graduate students, and undergraduate students. All of these employees lived and worked in the state, which is crucial as it means their salaries initially stay in the state as they spend for housing, food, and other living expenses. Furthermore, working for IAES provides valuable experience for all levels of students, increasing human capital through their added skills which adds to the productivity of the state economy.

Table 1 shows the FY 2016-17 expenses of IAES. In total, IAES spent over \$8.1 million on research and development activities, much of which were dollars that would not have otherwise entered the Idaho economy but for

³ See Appendix 1 for more information on economic impact methodology and model.

TABLE 1: Expenses by type of cost, FY 2016-17

EXPENSE ITEM	TOTAL	%
Salaries, wages, and benefits	\$3,202,645	39%
Capitalized software and equipment	\$2,246,092	28%
Other direct costs	\$2,696,862	33%
Total expenses	\$8,145,599	100%

Source: Data supplied by IAES.

IAES. These expenses would not have been possible without funding from outside the state from federal sources, which were then matched by state funding.

The first step in estimating the multiplier effects of IAES expenditures is to map these categories of expenditures to the approximately 1,000 industries of the Emsi Multi-Regional Social Accounting Matrix (MR-SAM) model. Assuming the spending patterns of IAES personnel approximately match those of the average consumer, we map salaries, wages, and benefits to spending on industry outputs using national household expenditure coefficients supplied by Emsi's national MR-SAM. Everyone working in IAES live in Idaho, and therefore we consider 100% of the salaries, wages, and benefits.

Mapping the other research expenses by category to the industries of the MR-SAM model requires some exposition. IAES primarily spends its research expenditures

on the life sciences research and development field. We map this fields of study to its respective industries in the MR-SAM model. The result is a distribution of research expenses to the various life sciences industries.

We now have three vectors of expenditures for IAES: one for salaries, wages, and benefits; another for capital items; and a third for purchases of supplies and services. The next step is to estimate the portion of these expenditures occurring inside the state. The expenditures occurring outside the state are known as leakages. We estimate in-state expenditures using regional purchase coefficients (RPCs), a measure of the overall demand for the commodities produced by each sector that is satisfied by state suppliers. For example, if 40% of the demand for the industry Offices of Certified Public Accountants is satisfied by state suppliers, the RPC for that industry is 40%. The remaining 60% of the demand for the industry is provided by suppliers located outside the state.

Table 2 presents the economic impact of IAES research spending. The people employed by IAES and their salaries, wages, and benefits comprise the initial effect, shown in the top row of the table in terms of labor income, non-labor income, total income, sales, and jobs. The additional impacts created by the initial effect appear in the next four rows under the section labeled multiplier effect. Summing the initial and multiplier effects, the gross impacts are \$5.3 million in labor income and \$1.3 million in non-labor income. This comes to a total impact

GLOSSARY

Economic impact analyses use different types of impacts to estimate the results:

Income impact: assesses the change in gross regional product, or GRP. Income is also synonymous with value added. It is comprised of labor income and non-labor income.

Labor income impact: assesses the change in employee compensation, or earnings.

Non-labor income impact: assesses the change in income and business profits.

Jobs impact: the number of full- and part-time jobs required to support the change in income.

Sales impact: comprises the change in business sales revenue in the economy as a result of increased economic activity. It is used interchangeably with output.

of \$6.6 million in total added income associated with the spending of IAES and its employees in the state. This is equivalent to 154 jobs and \$13.9 million in sales.

The gross impact is often reported by researchers as the total impact. We go a step further to arrive at a net impact by applying a counterfactual scenario, or what

TABLE 2: *Impact of IAES activities, FY 2016-17*

	LABOR INCOME (THOUSANDS)	NON-LABOR INCOME (THOUSANDS)	TOTAL INCOME (THOUSANDS)	SALES (THOUSANDS)	JOBS
Initial effect	\$3,203	\$0	\$3,203	\$8,146	108
Multiplier effect					
Direct effect	\$1,186	\$452	\$1,638	\$2,817	24
Indirect effect	\$170	\$54	\$224	\$427	3
Induced effect	\$781	\$754	\$1,535	\$2,484	19
Total multiplier effect	\$2,137	\$1,261	\$3,397	\$5,727	46
Gross impact (initial + multiplier)	\$5,340	\$1,261	\$6,600	\$13,873	154
Less alternative uses of funds	-\$599	-\$865	-\$1,464	-\$2,377	-17
Net impact	\$4,740	\$395	\$5,136	\$11,495	137

Source: Emsi impact model.

would have happened if a given event – in this case, the expenditure of in-state funds on IAES – had not occurred. IAES received monies from sources such as state-sponsored research awards and private donations. We must account for the opportunity cost of this in-state funding. Had other industries received these monies rather than IAES, income impacts would have still been created in the economy. In economic analysis, impacts occurring under counterfactual conditions are used to offset the impacts actually occurring in order to derive the true impact of the event under analysis.

We estimate this counterfactual by simulating a scenario where in-state monies spent on IAES are instead spent on consumer goods and savings. This simulates the in-state monies being returned to the taxpayers and being spent by the household sector. The results of this exercise are shown as negative values in the row labeled less alternative uses of funds in Table 2.

The total net impacts of IAES research are equal to the gross impacts less the impacts of the alternative use of funds – the opportunity cost of the state and local money. As shown in the last row of Table 2, the total net impact is approximately \$4.7 million in labor income and \$395,000 in non-labor income. This sums together to \$5.1 million in total added income and is equivalent to 137 jobs. The impact in terms of sales is \$11.5 million. These impacts represent new economic activity created in the state economy solely attributable to the operations of IAES.

Another way to interpret the results is to calculate an implicit multiplier. An implicit multiplier is the total impact divided by the initial effect. The implicit sales multiplier for IAES is the total sales impact of \$11.5 million divided by the initial spending of \$8.1 million, equal to \$1.41. In other words, for every dollar spent by IAES, an additional \$0.41 in added spending is generated in Idaho. We can do the same for income and for jobs. The implicit income multiplier is \$1.60, or \$5.1 million in total income impact divided by \$3.2 million in initial payroll spending. For jobs, dividing the 137 in total jobs impact by the 108 employees of IAES provides an implicit jobs multiplier of 1.27.

IMPLICIT MULTIPLIERS OF IAES RESEARCH SPENDING

An implicit multiplier is the total impact divided by the initial effect.

- The *implicit income multiplier* of IAES is \$1.60. In other words, for every dollar IAES pays its employees, an additional \$0.60 in income is created in Idaho.
- The *implicit sales multiplier* of IAES is \$1.41. In other words, for every dollar spent by IAES, an additional \$0.41 in sales occurs in Idaho.
- The *implicit jobs multiplier* of IAES is 1.27. In other words, for every person IAES employs, an additional 0.27 jobs are created in Idaho.

Funding the Future

The above demonstrated the economic impacts from current IAES expenditures. However, one of the biggest limits on how much work a research organization can conduct relates to its funding. It is therefore crucial for IAES to attract grant funding from both private and public sources to continue to provide the benefits it does. When it does so, additional sources of funding, such as from competitive grants for the USDA and private sources, enhance the impact of IAES. This is the beginning of a positive cycle, where the new research enabled by added grant funding will in turn draw attention to IAES and attract more funding.

According to figures provided by CALS, over the last three years the Aberdeen, Kimberly, and Parma Research and Extension Centers have attracted millions of dollars in grant funding. Averaging the total grant funding received across each of the last three years, Aberdeen received \$1.7 million annually, Kimberly received \$1.4 million, and Parma received \$724,000. These injections of funding to each Center accelerate the virtuous circle of more research, leading to more high-profile success, and further funding.

Broader Benefits of IAES Research

To illustrate the broad economic contribution IAES research creates, we highlight specific research areas at three Research and Extension Centers. In these areas, we calculated an annual impact of approximately \$11.0 million in added income, or \$37.6 million in additional sales, resulting from the implementation of IAES research. This excludes the \$178.5 million impact in one-time added income, or \$230.0 million impact in sales, resulting from IAES research mitigating a wheat epidemic in 2011. These are only a subset of the overall impact of the knowledge and intellectual property IAES develops; the full economic impact of this property is above and beyond what can be directly quantified.

About the Research and Extension Centers

Aberdeen

Established over a century ago, the Aberdeen Research and Extension Center has long played an important role in IAES activity. Today, the Aberdeen Research and Extension Center conducts research on important Idaho crops, such as potatoes, wheat, and barley, as well as other projects like finding ways to incorporate native plants into Idaho horticulture. The Aberdeen Research and Extension Center also hosts regular community events, learning opportunities, and more.

Parma

The Parma Research and Extension Center's research includes nematology, irrigation technology, hops, onions, and other crops. It also hosts community outreach services and Extension classes. For example, its annual Field Days events attract community members with tours of indoor and outdoor facilities, teaching sessions, and samples of new varieties the Center has developed. The Parma Research and Extension Center is also home to the USDA-ARS Horticultural Crops Research Unit Worksite, which creates valuable opportunities for shared research.

Kimberly

The Kimberly Research and Extension Center shares its laboratory and greenhouse space, along with its 180 acres of farmland, with the USDA-ARS Northwest Irrigation and Soils Research Laboratory, creating additional research opportunities and synergy. Today, the Kimberly Research and Extension Center conducts research in areas such as potato storage, irrigation efficiency, sugarbeets, and dry beans.

Potatoes

Potatoes are Idaho's most famous crop, so it comes as no surprise that potato production contributes significantly to the state's economy. In 2016, Idaho planted 325,000 acres of potatoes, producing over 139 million hundredweights (CWTs) valued at \$968 million. Idahoans produce more than one-third of the nation's potato production. Of these potatoes, about 60% are processed, while 30% are eaten fresh and the remainder are used as seed. Since many applications exist for potatoes, IAES research looks for ways to develop new potato breeds that meet specific needs, like the early-maturing and blight-resistant Blazer and the efficient Clearwater Russet varieties.

The industry standard potato is the Russet Burbank, the traditional brown-skinned potato perfect for french fries, and the primary potato variety used by restaurants such as McDonald's. IAES has developed the Clearwater Russet, a new variety with similar processing qualities but far less costly to produce. The Clearwater Russet holds particular potential if it is widely adopted in the place of Russet Burbank. For example, it could lead to an average savings of \$5.2 million per year in nitrogen fertilizer if producers replaced Russet Burbank with Clearwater Russet. This change would create an impact of \$5.1 million in added income for the state economy per year, or \$12.1 million in sales.

IAES research also helps Idaho's potato growers by improving storage technology. While they're stored, pota-

atoes face the threat of shrinkage and disease. IAES works to minimize this damage by developing new approaches to post-harvest diseases, particularly pink rot and late blight. Pink rot has usually been prevented with disinfectants, but the new phosphite application technique stemming from IAES research reduced the incidence of pink rot and late blight from 44% and 57%, respectively, to 1% and 7%. Using a conservative estimate, phosphites could save \$1.5 million in potatoes every year in Idaho alone. Further adoption of this approach nationwide will lead to even larger savings and impacts.

Wheat

Idaho planted 1.2 million acres of wheat in 2016, ranking 10th in the nation and producing almost 102 million bushels worth approximately \$710.3 million. IAES faculty and staff have supported Idaho's wheat farmers by developing several new varieties. Two of the most prominent varieties created include:

- **UI Sparrow**, a low protein soft white winter wheat producing an average yield of 104 bushels per acre, with a high yield of 134 bushels per acre and high resistance to snow mold, moderate resistance to stripe rust, and immunity to dwarf bunt. This immunity represents a savings of nearly \$37,000 in pesticide costs per 1,000 acres planted.
- **UI Silver**, a hard white winter wheat designed for the Asian noodle market with high resistance to dwarf bunt and to the stripe rust that affects its dryland growing region. It has a yield of 113 bushels per acre, with similar pesticide-cost savings as Sparrow wheat.

IAES also protects Idaho's wheat against disease. In 2011, IAES research was critical to protecting the wheat crop against a stripe rust epidemic that would otherwise have devastated wheat production. Certain wheat varieties could have had an estimated 80% yield loss. Thanks to preventative measures from IAES, losses were reduced to between 10 and 20% for those varieties. This amounted to an estimated savings impact of \$178.5 million in added income, or \$230.0 million in sales across Idaho.



Barley

Idaho's 2017 barley crop will be over 49 million bushels, produced on 480,000 planted acres. This represents nearly one-third of the nation's barley production, and a crop worth \$313 million in 2016. To support the barley crop, IAES research, in collaboration with USDA-ARS, pursues new frontiers in barley production. Idaho barley can be used for malting (i.e. beer production), for human food, or for animal feed. IAES research includes developing barley varieties for all uses.

In 2016, over 80% of Idaho's barley was used for malting, particularly by the large brewing plants in southern Idaho owned by Anheuser-Busch and Molson Coors. Malting barley requires different traits, such as low protein and beta-glucan content, compared to food barley varieties. To meet these significant needs, IAES developed barley varieties like Charles and Endeavor in 2005 and 2008, respectively. Approved by the American Malting Barley Association, these barley varieties are competitive with the industry standards.

IAES also develops food barley varieties. For example, Transit, a spring food barley variety, was developed to contain a high protein content and beta-glucan content, traits making it attractive to the significant Japanese barley market. Another IAES food barley, Kardia, has proven to produce \$158.40 more per acre than other food barley.

In addition to variety research, IAES helps keep barley crops healthy and productive. Currently, IAES faculty and staff are evaluating innovative irrigation techniques like Low Elevation Sprinkler Application (LESA) to help keep barley heads dry. Wet barley heads develop head blights that produce toxins, which can ruin entire crops. The LESA research also promises to create cost savings in water use for farmers who adopt it.

Hops

Along with malting barley, hops are crucial to Idaho's brewing industry, since hops, barley, yeast, and water are the key ingredients in beer. Hops are grown on vines, not unlike grapes, and require significant infrastructure

investment to economically produce. In 2017, Idaho's hop planting grew by 27% from 2016, up to roughly 7,200 acres. This is likely due to the increase in craft beer, which surpassed a 10% share of the overall US beer industry in 2016 and is experiencing increasing numbers of breweries. Furthermore, IPAs, which require high levels of hops, remain the largest category of craft beers and are expected to continue to grow.

IAES supports the hops industry primarily by helping to reduce two pest problems facing hops growers: California root borers and spider mites. California root borer beetles destroy the roots, spending as much as five years feeding on the vines' roots as larvae before revealing themselves as adults. The adult beetles are nocturnal, making it difficult to recognize the problem until the vines die. Since the trellis infrastructure required makes hop production very capital-intensive, losing crops is extremely costly. The faculty and staff at the Parma Research and Extension Center are working on a promising option to combat the infestation more cost-effectively via an innovative pheromone-based solution.

Spider mites, on the other hand, attack the leaves of a hop vine. They feed on plant cells, and their web starves the plants by blocking photosynthesis. If not treated effectively, they can destroy vast swathes of vines. Overall productivity and quality of the hops industry declines without the proper control for spider mites, reducing profitability for hops producers. Overuse of insecticides can lead to spider mites developing resistances, making it imperative for the station to continue evaluating new



safe and effective insecticides. Overall, identification of more effective and efficient insecticide use will result in cost savings to hops producers.

Irrigation

Water is critical for successful agriculture. All crops require water, at certain times and in various amounts, making IAES research on irrigation management and water conservation crucial to Idaho's farmers.

New methods of irrigation developed by IAES involve upgrading onion fields from inefficient furrow irrigation to a more controlled drip method. This saves an estimated 17 inches of water per acre, or approximately 1.4 acre feet of water. The new methods also increase the efficiency of chemigation and fertigation techniques by allowing nitrogen-based fertilizers to be injected through the water lines directly to the plants' root systems. This leads to greater nitrogen uptake efficiency, saving an estimated 1.2 million pounds of nitrogen per year.

IAES also supports Idaho's sugarbeet industry – the second-largest in the nation – by pioneering strip tillage methods. Strip tillage turns over less soil than other approaches, translating into both less time for farmers and more efficient soil usage. It creates the added benefit of decreased water runoff and moisture loss. Combined, producers could realize savings of \$11.6 million through IAES strip tillage techniques, providing Idaho with an estimated annual economic impact of \$5.0 million in added income, or \$20.8 million in sales.

Finally, IAES is conducting unique research around

unmanned aerial vehicles (UAVs) to help with Idaho's apple crop. Remote sensing technologies pinpoint the specific areas and trees requiring water, in conjunction with physical monitoring of the orchards. IAES faculty and staff have discovered the cost of monitoring orchards' water needs can be significantly reduced using UAVs; in IAES studies, UAV implementation has led to as much as a 20% reduction in water costs.

Nematode Prevention

Nematodes, also known as roundworms, are microscopic worms that live in soil and can be major pests to root vegetables. As a pest, nematodes infect potato tubers and sugarbeet roots and slow plant growth, reducing crop yield. For example, the pale cyst nematode and the golden nematode can reduce potato production by as much as 80%. To combat such losses, nematode research at the Parma and Kimberly Research and Extension Centers focuses on disease prevention and management.

The standard approach to eliminating nematode infestation has been fumigation. As a replacement, IAES pioneered the use of nematode-resistant crops such as oil radishes as a soil amendment for vulnerable crops. This approach has been effective with sugarbeet and potato crops, reducing infestation by as much as 92% and providing a combined gross annual benefit the University of Idaho estimated at \$32.9 million in 2000.

The nematode research and diagnostic laboratory helps Idaho farmers prevent nematode infestations before they begin, as well as effectively manage crops with a nematode presence. The Kimberly Research and Extension Center performs soil diagnostics to test for nematodes and the efficacy of pesticides through field trials. It also offers seed testing for farmers since all potato seed exported from the state must be tested and certified nematode-free. As a result, the rejection rate for potato seed has been reduced from approximately 6% to less than 0.5%.



Conclusion

For 125 years, IAES has worked to improve the quality of life for Idahoans by finding solutions to critical issues and providing learning opportunities to students. Every year, IAES faculty and staff spend millions of dollars in developing new crops, production techniques, and disease prevention methods. This would not be possible without an investment by the state. In return for the state's investment, IAES creates a significant economic value for the state of Idaho, while also nationally and internationally raising the University of Idaho's profile and attracting new grant funding. IAES research spending at Kimberly, Parma, and Aberdeen amounted to \$8.1 million in FY 2016-17, creating an impact of \$5.1 million in added income for the state. This can also be stated in terms of a sales impact, where IAES research spending created a total of \$11.5 million in additional sales. In other words, for every research dollar spent, \$1.41 in sales were created throughout Idaho.

IAES faculty and staff have developed new and improved varieties of Idaho's signature crop – potatoes. These new varieties have been recognized by some of the world's largest potato consumers. The varieties also increase the viability of stored potatoes by preventing diseases that may affect them. The development of better quality and more efficiently produced potato varieties, like Clearwater Russet, could create an annual impact of \$12.0 million in annual sales in Idaho if widely adopted. This

is equivalent to creating \$5.1 million in added income. Improved storage practices using techniques developed through IAES research could conservatively save up to \$1.5 million worth of Idaho potatoes on an annual basis.

Research at the Centers is crucial to the development of new varieties of key grains, such as barley and wheat, that can resist disease while providing key properties such as high protein content and above-average yields.



Idaho's barley crop was worth \$313 million in 2016. Recent IAES successes, in collaboration with USDA-ARS, include the approval of two barley varieties by the American Malting Barley Association. In addition to creating profitable new barley and wheat varieties, IAES prevented a stripe rust epidemic in 2011. We estimate this was responsible for a one-time economic savings impact of \$178.5 million in added income. This was equivalent to \$230.0 million in sales.

IAES also helps Idaho agriculture decrease costs and increase efficiency and revenue by improving irrigation methods. These new methods conserve scarce water resources while cutting costs – an obvious and significant benefit – associated with valuable crops such as onions and sugarbeets. Improved irrigation methods lead to additional savings in terms of the more efficient application of pesticides and fertilizers. IAES research on improved irrigation and tillage practices for crops like onions and sugarbeets can produce benefits responsible for up to \$5.5 million in added income per year, which is equivalent to \$22.7 million in additional sales.

Taken together, these activities provide a sense of how important IAES, CALS, and the University of Idaho are to the state's agricultural economy. While not all research can be directly quantified, the research highlighted here yields an estimated annual impact of \$16.1 million in added income and \$49.1 million in added sales of the state due to activities at Parma, Kimberly, and Aberdeen. This is just a snapshot of the research and outreach activities taking place, yet it demonstrates a strong return on the state's investment in IAES. The reach of IAES extends far beyond the scope of this analysis, and as it has for the past 125 years, it will continue to serve the state and society as a whole.



Appendix 1: About Economic Impact Analyses

Economic impact analyses use different types of impacts to estimate the results. The one we focus on the most in this analysis is the **income impact**, which assesses the change in gross state product, or GSP. Income may be further broken out into the **labor income impact**, which assesses the change in employee compensation; and **the non-labor income impact**, which assesses the change in income and business profits. Another way to state the income impact is in terms of **jobs**, a measure of the number of full- and part-time jobs that would be required to support the change in income. Finally, a frequently used measure is the **sales impact**, which comprises the change in business sales revenue in the economy as a result of increased economic activity. It is important to bear in mind, however, that much of this sales revenue leaves the state's economy through intermediary transactions and costs. All of these measures – jobs, income, and sales – are used to estimate the economic impact results presented in this analysis.

The analysis breaks out the impact measures into different components, each based on the economic effect that caused the impact. The following is a list of each type of effect presented in this analysis.

- The **initial effect** is the exogenous shock to the economy caused by the initial spending of money, whether to pay for salaries and wages, purchase goods or services, or cover operating expenses.
- The initial round of spending creates more spending in the economy, resulting in what is commonly known as the **multiplier effect**. The multiplier effect comprises the additional activity that occurs across all industries in the economy and may be further decomposed into the following three types of effects.
 - The **direct effect** refers to the additional economic activity that occurs as the industries affected by the initial effect spend money to purchase goods and services from their supply chain industries.

- The **indirect effect** occurs as the supply chain of the initial industries creates even more activity in the economy through their own inter-industry spending.
- The **induced effect** refers to the economic activity created by the household sector as the businesses affected by the initial, direct, and indirect effects raise salaries or hire more people.

The terminology used to describe the economic effects listed above differs slightly from that of other commonly used input-output models, such as IMPLAN. For example, the initial effect in this study is called the “direct effect” by IMPLAN, as shown below. Further, the term “indirect effect” as used by IMPLAN refers to the combined direct and indirect effects defined in this study. To avoid confusion, readers are encouraged to interpret the results presented in this section in the context of the terms and definitions listed above. Note that, regardless of the effects used to decompose the results, the total impact measures are analogous.

Emsi	Initial	Direct	Indirect	Induced
IMPLAN	Direct	Indirect		Induced

Multiplier effects in this analysis are derived using Emsi’s Multi-Regional Social Accounting Matrix (MR-SAM) input-output model that captures the interconnection of industries, government, and households in the state. The Emsi MR-SAM contains approximately 1,000 industry sectors at the highest level of detail available in the North American Industry Classification System (NAICS) and supplies the industry-specific multipliers required to determine the impacts associated with increased activity within a given economy.⁴

4 Please contact Emsi for more information on the Emsi MR-SAM.

Example of Sales Versus Income

Emsi's economic impact study differs from many other studies because we prefer to report the impacts in terms of income rather than sales (or output). Income is synonymous with value added or gross state product. Sales include all the intermediary costs associated with producing goods and services. Income is a net measure that excludes these intermediary costs.

For this reason, income is a more meaningful measure of new economic activity than reporting sales. This is evidenced by the use of gross domestic product (GDP) – a measure of income – by economists when considering the economic growth or size of a country.

To demonstrate the difference between income and sales,

consider an example of a baker's production of a loaf of bread. The baker buys the ingredients such as eggs, flour, and yeast for \$2.00. He uses capital such as a mixer to combine the ingredients and an oven to bake the bread and convert it into a final product. Overhead costs for these steps are \$1.00. Total intermediary costs are \$3.00. The baker then sells the loaf of bread for \$5.00.

The sales amount of the loaf of bread is \$5.00. The income from the loaf of bread is equal to the sales amount less the intermediary costs.

In our analysis, income can be found by summing the labor income and non-labor income. To provide context behind these figures, we also report the number of jobs associated with the income. The impacts are also reported in sales terms for reference.