



**AgEcon** SEARCH  
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

Give to AgEcon Search

AgEcon Search

<http://ageconsearch.umn.edu>

[aesearch@umn.edu](mailto:aesearch@umn.edu)

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

Developing a Holistic Assessment for Land Grant University Economic Impact Studies:

A Case Study

Elli Travis\*, Albert Alwang\*, Jeremy Elliott-Engel\*\*

Virginia Tech

\*Office of Economic Development

\*\* Department of Agricultural, Leadership, and Community Education

Correspondence concerning this article should be addressed to Elli Travis at [emtravis@vt.edu](mailto:emtravis@vt.edu)

Abstract

A southern Land-Grant University (LGU) conducted an economic impact study of its Cooperative Extension and Agricultural Research Centers. The Association of Public and Land-Grant Universities promotes the use of economic impact studies, however their design is business innovation-centric, deemphasizing the human capital development component that Extension provides. Literature on economic impact theoretical frameworks or proven methodological approaches to assess both the technical and human innovation side of an organization of this size, scale, and scope is limited. This led to the design of an exploratory qualitative study to determine what impacts should and could be measured, and how to attribute an economic value to particular research and extension programming. An analysis of input from industry stakeholders, administrators, and practitioners helped determine that the dominant economic impact assessment tools: large scale input-output models and small scale return on investment and productivity studies, have limitations in accurately operationalizing economic impact calculations for such a large state-wide organization. Initial results of this study demonstrate that both public and private innovations and technical assistance have impacts on the economy. This study exposed measures, methods and recommendations for future economic impact study design.

### Developing a Holistic Assessment for Land Grant University Economic Impact Studies:

#### A Case Study

Land Grant Universities are fundamental bedrocks of innovation and economic vitality for states and are often credited with the growth in agricultural productivity in the US (Zumeta, 1998). Funding is critical to the research, teaching and extension missions of the LGU, yet many states continue to cut financial support. Experts caution that the rate of agricultural productivity will decline in the coming decades as a result of diminished research investments; ensuring financial support now is essential for future productivity and economic growth in coming decades (Anderson, 2015; Joly, Gaunand, Colinet, Larédo, Lemarié, & Matt, 2015; Joly, Colinet, Gaunand, Lemarié, & Matt, 2016). To justify continued funding, states are asking LGUs to produce assessments of their economic impact (Anderson & Feder, 2004).

Traditionally economic impact assessment focuses on determining the difference between the state of an economy with the presence of the object of study versus its counterfactual, or the state of an economy without the object of study. A counterfactual is relatively easy to assess for small organizations with singular missions, or events with visitors in attendance for a specific purpose. Assessing the economic impact of a complex organization like an LGU is challenging, first because it is impossible to cleanly identify whether the funding would exist without it; and second because traditional input-output models are static and do not account for technological advancements and productivity gains that result from research and extension efforts.

The purpose of this study is to explore alternative ways of assessing the economic impact of agricultural research and extension programming. To do this, we examine the case of Agency 229, which funds Virginia Cooperative Extension (VCE) and the Virginia Agricultural

Experiment Stations (VAES). Together these two entities conduct research and deliver community-based education on wide-ranging topics that are of concern to the state. Given the broad nature of Agency 229's work and the failure of traditional economic impact models to respond to complexity, how does such an institution measure its economic impact in a comprehensive and fair manner?

The study begins with an overview of the literature on economic impact assessment methodologies and alternative ways of valuing agricultural research and extension in the agricultural economics and extension education fields. The methods section details the qualitative approach used to explore the impacts of Agency 229 on the economy of Virginia with a focus on internal versus external stakeholder perspectives. Results center around the types of impacts reported by stakeholders and their real and hypothesized influence on the economy. The paper concludes with a discussion of valuation and the importance of including multiple perspectives when assessing economic impact.

### **Literature Review**

An LGU generates economic impacts in several ways. First, it spends money on personnel and infrastructure, which directly and indirectly affects the economy. Second, it generates innovation that results in technical advancements. Third, it promotes human and social capital changes which have impacts on regional and state economies. Finally, many extension and research activities have impacts on the natural environment, which provides direct and indirect benefits to the economy. Approaches to measuring these types of impacts are varied. A focus on direct spending as a proxy for impact often excludes the influence of research and extension efforts on economic growth, and overemphasizes the effect of direct personnel and infrastructure spending. Studies focused on the impact of agricultural innovations are often small

## DEVELOPING A HOLISTIC ASSESSMENT FOR LGU EI STUDIES

in size and scope, and generally focus on agricultural products that have been commoditized. Placing economic value on social and human capital and environmental benefits is similarly difficult, as valuation of services provided differ across stakeholders.

One way agricultural economists assess the economic impact of agricultural research and development is through a quantification of the value of specific research programs or innovations. Agricultural research and development assessment can be sorted into ex ante and ex post evaluations (Norton & Davis, 1981). Ex post evaluations can be categorized into two distinct groups “(a) those using consumer and producer surplus directly and estimating an average rate of return to research, and (b) those estimating a marginal rate of return to research by treating research as a production function variable. (Norton & Davis, 1981, p. 685).” Ex ante evaluations fall into four different typologies. They include (a) those using scoring models to rank research activities, (b) those employing benefit-cost analysis to establish rates of return to research, (c) those using simulation models, and (d) those using mathematical programming to select an optimal mix of research activities (Norton & Davis, 1981). Rao, Hurley, and Pardey (2014) conducted a review of 2,186 published rates of return in 359 different studies and found that results were inaccurately inflated, as they often assumed linear rates of returns to R&D.

In an effort to calculate impact of organizations similar to Agency 229, and gauge the impact of the organization’s research on the economy, evaluators often compare dollars received from federal and private sources against monies received from state sources to calculate a return on investment or “funds leveraged.” In order to extrapolate an accurate rate of return on public investment it is important to clearly define investment figures and to ensure duplication of values are eliminated. The Association of Public and Land Grant Universities (APLU) recommends the use of IMPLAN, an input-output (I-O) software, for these types of studies. I-O models have

some the similar limitations as the previously discussed studies as they estimate constant returns to scale using multipliers (Jin and Huffman, 2016). In APLU's 2014 publication, the organization provided guidelines aimed at assisting practitioners in these types of assessments, emphasizing the need to include the influence of university-based innovation in addition to the traditional economic impact calculation of education conducted through Extension and agricultural research experiment stations (Ambargis et al., 2014; APLU, 2014).

There is a growing recognition of the complexity involved in assessing the adoption of innovations and the resulting impacts. Joly et al. (2016) focus on economic impact in order to measure the broader themes of agricultural impact research and development (R&D) beyond a calculation of Internal Rate of Return (IRR). This was in response to the growing interest in understanding Research Impact Assessment (RIA) at the institution and funder/agency level. The authors were concerned with the efficiency with which public funds are used and how to improve the functioning of the research and innovation system, all while recognizing its contribution to a wide range of socio-economic and environmental issues. Joly et al. (2016) recommended that in order to discuss RIA a mix of both standard economic impact approaches as well as case-studies - to provide a narrative - are needed to explain the complex relationships between programmatic efforts and impacts.

Joly et al. (2016) further identified that improving agricultural productivity had impacts on a multitude of current issues, including: "Dealing with environmental issues; Improving health: safety and healthy food provision, safety working conditions; Enhancing the social value of agriculture: poverty alleviation, maintenance of viable rural areas and quality of life in rural areas; and, Reducing food waste" (P. 8). The societal impacts from research are produced from a network of actors and this network evolves along with the impacts (Joly et al., 2016). Maru,

Sparrow, Stirzaker, & Davies (2016) identified that impact pathways are influenced by 1) market linkage, (2) social capital, (3) institutional change or (4) innovation capacity. In order to acknowledge these fundamental implications and still assess impact. Joly et al. (2016) recommended that the measure of economic impact analysis should not be attribution analysis, but contribution analysis. They defined attribution as identifying causal relations and estimating quantitatively how much of an observed impact is due to the intervention of a given organization (Avila et al., 2015; Joly et al, 2016). “Attribution supposes that the different causes that produce a given effect are additive, which contradicts what is observed in complex ecosystems of innovation, namely the key importance of synergistic (non-additive) interactions. Therefore, attribution may usefully be replaced by a contribution approach (Joly et al., 2016). Maru et al. (2016) introduce the use of Innovation Platform (IP) as its operational instrument. IP is a forum for a group of relevant actors along the value chain of a specific commodity or system of production. The actors include farmers, researchers, extension agents, traders, processors, financial institutions, policy makers, regulators, output market operators, consumers and others. These multiple stakeholders address the complexity by identifying problems jointly, investigate solutions leading to the generation of innovations and accompanying social and economic benefits (FARA, 2017; Nguyen, Van De Fliert, & Nicetic, 2015).

In addition to the economic benefits of agricultural R&D, research and extension systems also play a critical role in environmental conservation. Environmental resources provide benefits in the form of public goods (Tietenberg & Lewis, 2016). Environmental degradation has a clear economic impact which is easily identified and measured, however improvement and economic contribution of the environment becomes uncertain (Vardakoulias, 2013). The environment in this case becomes a complex good.



## DEVELOPING A HOLISTIC ASSESSMENT FOR LGU EI STUDIES

“Complex goods may be considered as those which are not commonly experienced through use. However, their existence or preservation may be valued by the respondent and by society. Their value is therefore largely a non-use as opposed to a use value” (Hutchinson et al., 1995, p.98).

The environment provides both direct use value and non-use value to the economy. Use-value are things such as clean water, air, or productive soil which for an industry like agriculture becomes fundamentally important. Non-use values are attributes with more intangible attributes, such as ‘beautiful’ landscapes which essential for an industry like tourism. However, non-use values measures are less clear (Vardakoulias, 2013). Contingent Valuation Method (CVM) was recognized by Hutchinson et al. (1995) as the only way to measure non-use value of environmental goods but challenging to measure. Combining the use values and non-use values together forms the total economic value (TEV) of an ecosystem or resource (Vardakoulias, 2013). In order to measure the economic impact an entity has on the ecosystem, a base-line TEV needs to be calculated and then attribute contributions to the ecosystem from the entity or action. These contributions can be generated from alterations in market prices, averting behavior (Vardakoulias, 2013), or hedonic pricing - i.e. proximity to a hog farm alters the residential value of homes (Sirmans, Macpherson, & Zietz, 2005).

Instead of measuring the economic impact of human capital changes, LGUs that provide services beyond education, have relied on multiplier models (i.e. I-O) or have communicated community improvements through narrative. More challenging is Agency 229 and similar Cooperative Extension organizations need to communicate their value to a myriad of stakeholders. In an attempt to communicate personal and public goods to stakeholders they have relied heavily on quantitative and qualitative narrative. In a review of 50 peer LGUs, simple narrative was the singular approach to communicating impact across Cooperative Extension. These narratives include information such as: program attendance numbers, short-term behavior

## DEVELOPING A HOLISTIC ASSESSMENT FOR LGU EI STUDIES

change measures, and individual personal impacts or success stories. This remains the dominant approach for communicating Cooperative Extension and the Research Station's efforts.

To turn this narrative into a logical argument for impact, Cooperative Extension shifted towards the use of impact statements or public value statements (Kalambokidis, 2004, 2014). Public value statements are short overviews that convey how Extension programs induce participants to act in ways that benefit others in the community (Kalambokidis, 2003, 2011). Public value statements incorporate the language of the logic model to help the reader draw a conclusion between the participants' intended knowledge change and the impacts -or potential impacts- on society as a whole. Public value statements can make both quantifiable or qualitative conclusions. Based on a systematic review of Land-Grant Universities state-level annual reports at least five states use public value statements as a method to streamline, format, and convey the essential human capital and economic impacts of Cooperative Extension. Another narrative approach to communicating impact is the impact statement. At least nine agencies, including the subject of this study, use this method. Impact statements are concise, but meaningful overviews of program results that communicate the differences that Extension efforts make in people's lives (Diem, 2013; O'Neill, 1998; Johnson & O'Neill, 1999). Impact statements do not require a connection to public value. These statements are utilized to highlight both public and individual benefits that Agency 229 had achieved through educational programs. These impacts are generally not linked to economic impacts unless the program outcomes related to economic improvement and generally rely on one agent's perspective of the influence of a program.

Virginia Tech's Agency 229 economic impact study (to the authors' knowledge at the time of publication) is unique. Previously, economic impact studies have been conducted at the Extension or agriculture research project level, at the Program-area levels, or, they have been at

## DEVELOPING A HOLISTIC ASSESSMENT FOR LGU EI STUDIES

the whole-university level. Because Agency 229 and entities similar to it were only components of the larger-institutions study, they received limited attention in the whole university economic impact studies conducted even though Agency 229 entities are large complex organizations in their own right. Additionally, even with the completed economic impact studies, for similar entities to Agency 229, their scope has been limited, focusing solely on direct impacts. To overcome the challenges placed by the complexity of Agency 229, this study relies on qualitative methods to explore potential adjustments to how Cooperative Extension and State Agriculture Experiment Stations can report and track their complex economic impacts..

### **Case Study Context**

Agency 229 funds Virginia Cooperative Extension (VCE) and the Virginia Agricultural Experiment Station (VAES). VCE operates using a county-based model, with presence in 107 rural and urban communities throughout the Commonwealth. Agents are supported by specialists at one of four district offices and by faculty at Virginia Tech's main campus. VCE programming is ideally tailored to each community's unique needs and is administered through four program areas. Family and Consumer Sciences (FCS) takes a holistic approach to community development, providing nutrition and wellness, family financial education, and human development programming. 4-H Youth Development encourages youth to participate in a variety of activities that foster leadership skills. Community viability activities include connecting members of a community and facilitating development through leadership and planning, community enterprises and resiliency and community food systems. Agricultural and Natural Resources (ANR) agents put on educational programming and provide direct technical assistance to producers and home/landowners. Agents are supported by roughly 30,000 volunteers.

## DEVELOPING A HOLISTIC ASSESSMENT FOR LGU EI STUDIES

Research is conducted at 11 agricultural research and extension centers (ARECs) throughout the commonwealth, of which Virginia Tech's main campus in Blacksburg is one. The research at those facilities is largely applied, and directly relevant to local agricultural and natural resource needs. Agency 229 faculty are also engaged in basic research through the colleges of Natural Resources and Environment, Agriculture and Life Sciences, and Veterinary medicine.

### **Methods**

The research was divided into two phases. Phase One was largely exploratory, focusing on identifying Agency 229 research and extension programming and accompanying outcomes and impacts through discussions with senior VCE and VAES administrators. During Phase Two the research team uncovered examples of the influence of research and extension on specific industries and communities, using interview, focus group, and survey data from internal and external Agency 229 stakeholders. The data gathered in these phases was analyzed using a combination of qualitative coding and a calculation of monetary impacts of technologies and programs when a counterfactual could be identified. A report prepared for Agency 229 focused on the research and extension activities relevant to specific industries with recommendations of where additional resources might be used to enhance impacts. An additional round of analysis informed the results included in this paper.

#### ***Phase One***

The first phase of research focused on building a roadmap or theory of how extension and research activities lead to economic growth and development impacts from the perspective of senior 229 administrators. While list of grants and intellectual property disclosures helped

## DEVELOPING A HOLISTIC ASSESSMENT FOR LGU EI STUDIES

identify inputs and activities, interviews proved to be the most useful in terms of tracing those activities to outcomes and impact. Fifteen administrators representing each of the three Agency 229 colleges, each regional extension office, and central extension and research administrators participated in interviews. These interviews followed a standard format. First, interviewees described key research and extension activities. Then, they described the relationship between their department/office and industry and community partners followed by an explanation of the ways in which they believed their activities influence community and economic development. Probing questions included queries about what the technical assistance clients did with the information provided, the adoption rate of new technologies, and the calculated return on investment of technologies developed and/or disseminated. Finally, interviewees explained if and how they evaluate the influence of their activities on outcomes. Each interview was coded first according to its place in the logic model (input, activity, output, outcome, and impact), and second according to a key theme or impact area.

Information from these initial interviews, time allocation reports, and a selection of impact statements were combined into an initial logic model showing the inputs, activities, outputs, and impacts of Agency 229. Given the breadth of hypothesized impacts on many areas of the economy, the authors decided to focus phase two on tracing the causal linkages of the logic model within specific industries and specific communities.

### *Phase Two*

The second phase attempted to validate the elements of the logic model, specifically the outputs, outcomes and impact through an industry and community case study lens. Advised by the research team, administrators chose five industries according to their relative contribution to state GDP as well as the depth and breadth of 229 research and extension efforts. The industries

## DEVELOPING A HOLISTIC ASSESSMENT FOR LGU EI STUDIES

are: 1) Beef cattle; 2) Vertically integrated poultry production systems; 3) Forestry/wood products/ timber; 4) Food and beverage processing; and 5) Row crops. To assess localized impacts in communities, researchers analyzed the influence of extension and research efforts in three counties and one independent city.

For the industry-focused piece, Agency 229 administrators identified four external and two internal stakeholders for each industry. The external stakeholders included representatives from private corporations who participate in research and/or extension activities and the leaders of commodity associations that represent individual producers. Internal stakeholders included department heads whose research focuses on one of the industries, as well as extension representatives who meet regularly with industry or producer groups. Interviewees described specific research or extension activities with which they were familiar, explored strategies or technologies adopted by the company or producer(s) represented by the interviewee, and explained the benefit of adopting those technologies or management practices. Each interviewee explained the ways they thought the individual and collective efforts of 229 affected the economy of Virginia. They also responded to questions about upcoming industry needs, and the ways in which Agency 229 could assist them in meeting those needs.

229 uses a county-based extension model and for this reason we defined a “community” as a particular county or independent city. Central administration chose eight such communities, dispersed economically and geographically. Of those, four were ultimately chosen based on demographics and geography: one urban county with a large and growing immigrant population; one city on the coast with a majority minority community and a mix of urban and rural stakeholders; one rural county with large-scale tobacco and dairy operations; and one rural county representing both small niche and large-scale production in the cow-calf producing

## DEVELOPING A HOLISTIC ASSESSMENT FOR LGU EI STUDIES

section of the state. Three sources of data were triangulated to develop each case study: impact summaries, focus groups with agents, and stakeholder survey responses.

The case studies each began with a collection of secondary data about the economy of the city/county, key agricultural products, total agricultural exports, and number of farms and agricultural producers. The secondary data was followed by an analysis of impact statements written by agents in each of these communities over the last five years. Next, researchers conducted group interviews with extension agents in each community. Each interview began with a request to describe the biggest challenges facing stakeholders in that community, and the ways in which the extension service responds to those challenges. Then, the agent(s) described their work in each of four program areas and the way that they thought that work influenced their community. Depending on the program and agent, some specifics were available in relation to number of attendees at events and outcomes of specific types of programming.

To supplement these interviews, agents in each city/county identified 20 stakeholders in government, education, and industry for input via an electronic survey. Through this survey, stakeholders described their involvement with extension, their level of participation in the four core extension areas, and the ways in which they saw activity in each area contributing to economic growth and development. Using these three sources of data, researchers were able to develop a picture of the ways in which research and extension programming affects communities as well as the ultimate effect of that programming on the economy of a community.

Analysis focused on analyzing and corroborating the reported impacts of Agency 229 within each industry and community. For some industries, there were indications that data had been collected about the efficacy and adoption of practices and technologies, and pricing information was available to assess the monetary impact of those activities. In those cases,

researchers defined a counterfactual and conducted a calculation of economic impact. However for many of the activities deemed "impactful" by interviewees, there was little or no quantitative data available to quantify impact. However they described the linkages between research and extension activities and tangible effects for themselves, their representative industries, communities and the economy.

### **Results**

The qualitative approach of the study allows for the tracking of Agency 229 activities through an industry and community frame, in an attempt to provide an economic valuation of its work. Discussion with industry, commodity associations, and community stakeholders uncovered clear measurable impacts of research and extension programming, as outlined in the logic model. In many cases, interviews included compelling stories validated by profits, jobs, and economic growth in the focus industries and communities. However, this is also only part of Agency 229's *true* economic impact; many of the tangible benefits to Virginia's economy and populations are influenced by activities on an individual or community scale. These impacts are generated by programs with both short and long term benefits and with economic valuation that varies depending on the stakeholder. Collectively these impacts provide a challenge for establishing metrics and scaling evaluations, leaving a gap between large economic figures that aggregate the impacts of multiple research and extension program areas, and more anecdotal evidence provided by industry, researchers, and extension agents. The lack of a precise economic valuation does not diminish the findings of the economic impact Agency 229 provides to Virginia's economy. In fact, industry and producer representatives emphasize the importance of activities that fall in the latter category. Moreover, industry often stressed the expansion of



## DEVELOPING A HOLISTIC ASSESSMENT FOR LGU EI STUDIES

programs dealing with human and social capital development or environmental health as a pathway to enhance the agency's economic impact and relevance.

### ***Impact 1: Higher returns and profits***

Research and discovery at Agency 229 leads to innovation and new technologies that influence industry practices and operations. Industry adoption of these technologies can lead to reduced costs, increased productivity, new markets, and even the development of new products. Diffusion of this research comes in many forms. In some instances, agents integrate new information and technology into programming and direct technical assistance that informs public and private stakeholders. Alternatively, faculty work directly with private companies who fund research or collaborate jointly on the development of products and technologies.

Agency 229's row crop program aptly illustrates the mechanism of research influencing profits. Improved variety research leads to patented varieties that are released for both public and private use throughout the United States. Producers in Virginia benefit from the adoption of improved varieties in terms of reduced input costs and higher yields. Two peanut varieties developed through a multi-state extension program, have brought farmers more than \$16 million since their introduction. In addition, royalties from small grain licenses have totalled \$3.7 million over the past five years, which goes directly back into the research program and spurs additional innovation. Row crop programming goes beyond varietal improvement, and includes pest and disease control, prudent pesticide application, and efficiency improvements. Such programming is cited as having strong economic importance. Researchers and row-crop industry representatives estimate conservatively that, based on the influence of improved varieties and management practices on yields, wheat and barley research and extension reduces estimated costs of production by \$2.4 million annually; improved management training brings in an

## DEVELOPING A HOLISTIC ASSESSMENT FOR LGU EI STUDIES

additional \$2.2 million dollars to corn producers annually; and soybean producers gain an additional \$1.3 million in income annually, all attributed to the joint research and extension efforts.

Agency 229 research facilities are critical points of joint collaboration for research and development. Food and beverage representatives highlighted the work occurring at a pilot plant on the University's campus as particularly impactful. The facility has the technology and capabilities of leading food and beverage manufacturing companies. Companies come to the facility for product development, safety validation testing, or learn new procedures to apply in their production. Safety validation and product testing conducted at the pilot plant frees up productive manufacturing space at production facilities. In one case, safety validation of a product for one multinational company led it to expand its product line via a \$36 million investment in the state. In another case, VAES researchers helped a company avoid a multi-million dollar investment by showing them that their current manufacturing process was just as efficient as the proposed new one.

### ***Impact 2: Money in the pockets of Virginians***

This industry impact fits closely with economic impact assessments using I/O models to track the the economic activity generated by *new* money created by a program or technology. As new jobs, wages, or programs provide a direct effect in economic activity, additional indirect and induced effects occur as higher incomes or revenues lead to more spending. Moreover, programs that produce this type of impact present a clear causal attribution to Agency 229's VCE and VAES. Without the activity the money would not be present in the economy.

## DEVELOPING A HOLISTIC ASSESSMENT FOR LGU EI STUDIES

Agency 229 involvement with the cattle industry demonstrates how programs can leverage outside investment for Virginia producers and amalgamates the many elements of a state-wide extension programs, including non-formal learning, technical assistance, and applied research. VAES conducts research on improving cattle health and nutrition, vaccinations, alternatives to antibiotics, and improved genetics. This research is synthesized into training and certification programming available to all state cattle farmers, administered by VCE. The Virginia Quality Assured Feeder Cattle Program certifies producers who apply proper herd health management practices and record keeping techniques. Once a critical mass of certified producers and associated feeder calves is reached, a VCE agent works with a member of the Cattlemen's association to market the load to midwest feed lots who buy at premiums up to \$100 over typical market price. In 2016, BQA-certified producers received an estimate extra \$1.5 million, leading to a statewide economic impact of \$2.5 million (this is a combination of direct, indirect, and induced economic effects modeled in IMPLAN). This economic impact would not be in the state in the absence VCE. Additionally the collaboration with the industry association has led to Virginia's growing reputation nationally as a premier location for feeder calves, which are purchased by buyers in the Midwest at premium prices.

Agency 229's forestry programs support an intergenerational transfer of money through its SHARP Logger program. SHARP Logger has trained over 4,000 individuals, educating participants on logging safety, sustainable forestry, harvest planning, and best management practices. The program is supported by the timber industry and the Sustainable Forestry Initiative (SFI). In a post-course survey, over 63% of logging business owners reported of having made changes or improvements in operations after attending SHARP Logger programs. Another reported result from SHARP programming is forest owners and loggers can effectively harvest

softwood every 25 years and hardwood every 50 years. For reference, an industry expert stated that poorly managed hardwood forest generally have the ability to be harvested every 75-100 years. Therefore, Virginia hardwood forests would be able to double their returns over a 100-year period if every forester, logger, and forest owner participated and completed SHARP training. Furthermore, sustainable harvesting ensure younger generations will be able to reap the benefits of this natural asset.

### ***Impact 3: Virginia jobs***

Creation of new jobs leads to substantial economic development and provides distinct metrics when conducting an impact assessment (Drucker & Goldstein, 2007). Many Agency 229 activities foster job creation or ensure continued employment through producer support.

Producer association representatives underscored the importance of producer support through education, training, and technical assistance as a vital component of maintaining a vibrant agriculture economy. In addition, food and beverage manufacturers and livestock companies expressed the need to continue and expand support of farmers who provide raw inputs into their products.

One industry where extension serves large corporations through small-scale producer support is in the poultry industry. This industry is increasingly adopting vertical integration where a large portion of production is controlled by a single entity that owns the feed, animals, and meat processing facilities, with individual operators producing meat under contracts. Integration lowers production costs, leading to lower consumer prices and reducing financial risks for both poultry farmers under contracts. Along with job creation in processing, manufacturing, and on-farm employment, the poultry industry contributes to supply chain jobs, including feed production and manufacturing, poultry research and education. The scale of these

## DEVELOPING A HOLISTIC ASSESSMENT FOR LGU EI STUDIES

companies allows them utilize resources from all over the country, however they have limited resources in outreach to serve the scores of producers in their supply chains. VCE supports contract growers by providing technical assistance on the nutrition of their animals, disease management, and pollution control. Without this technical assistance to contract growers, the poultry industry in Virginia would fail to thrive.

In addition to supporting large companies, 229 helps food entrepreneurs start businesses. The Food Innovations Program educates food entrepreneurs on food processing and safety regulations, starting a food business, and food labeling. They also provide product testing. In 2016 alone, the program served 450 individuals and analyzed 250 food products, enabling entrepreneurs to pass regulatory standards and enter into the market. While the number food businesses starting as a result of participation in this program has not been captured, stakeholders shared several anecdotes, including one small businesses of \$1 million and 10 employees that remained open as a result of product safety validation and recommendations for improvement.

### ***Impact 4: Knowledgeable, healthy citizens***

One of the biggest assets for industry are the citizens that are employed. Citizens benefit from a wide range of research and extension activities that better prepare them through training and certification. Additionally, a large portion of community-based extension programs support the growth of healthy and vibrant communities.

Forestry industry representatives emphasized the educational gains from Agency 229's Virginia Forest Landowner Education Program, which provides short courses on best management practices, like devising a forest management plan. 50% of program participants report creating a management strategy plan following the course, which is a practice adopted by

## DEVELOPING A HOLISTIC ASSESSMENT FOR LGU EI STUDIES

only 3% of landowners nationally. Industry values this program as it ensures sustainable forestry practices by private landowners who are an integral piece in the timber supply chain. Moreover, the tourism industry benefits from the preservation of wildlife habitat and strategies to deter invasive species in forests around the state. Another program preserving an economic asset through public education is VCE training in Virginia Beach on rain barrel collection systems and stormwater management. This program ultimately protects the waterways vital to the regional economy.

Community development is a key component of VCE activity, which presents a challenge for evaluators looking to quantify the impacts of a healthy and happy community. However, industry often cited these programs as being an important part of attracting and retaining workers and improving soft skills that are needed in a professional environment. Alternatively, community representatives explained that many of these programs are essential in improving the welfare of community members. For example, Family and Consumer Science programs cover topics including nutrition and wellness, family financial education, and family and human development. SNAP education, budget support, housing support (i.e. first time home-buying and foreclosure avoidance), and home and family education on parenting and communication skills are a few examples of programs that support community wellness. Extension agents often conduct these programs together with state agencies (Departments of Corrections, Housing, and Human Services) to target the most vulnerable populations in a community in order to alleviate poverty.

### ***Industry Impacts Outside of Logic Model***

The preceding examples of economic impact corroborate what was predicted by Agency 229 administrators. However, industry and producer group representatives continually cited

additional unintended effects as playing a critical role in their operations. These impacts are often viewed as tertiary in importance in economic development as well as extension reporting and program design. Moreover, they represent a challenge in economic assessment as the value of the service or attribution to 229 differs depending on the perspective of the stakeholder. The following results illustrate economic impacts that are critical in fostering economic growth and development.

*Regulations* are a frequent hinderance for industries and small-scale producers alike. Navigating federal, state, and local regulation puts a strain on the resources available to agriculture producers and companies. Industry constantly relies on extension outreach and technical knowledge to help producers adhere to relevant regulations. One way to measure this service is evaluating the costs avoided by industry. However, from the perspective of the producer, this information allows them stay in business and reduces cost associated with understanding regulations. Moreover, this may be the final step to enter the market for food entrepreneurs, suggesting jobs created by new business can be attributed to this service.

Another example of the benefits of assisting producers in complying with environmental regulations is in poultry litter management. Litter management is the responsibility of small-scale contract growers, and can be extremely burdensome and costly. In response to a realization of the negative environmental impact of non-point source pollution in the Chesapeake Bay, legislators sought to prohibit the application of poultry litter on row crops. In response, VCE developed a phosphorous site index and accompanying training program that allows contract poultry growers to continue to use litter on their feed crops in a more environmentally friendly way. Allowing contract growers to apply fertilizer on their own fields enables them to produce

their own feed and reduces both feed and disposal costs. Moreover, the program has aided the substantial growth in poultry industry in the state.

*Environmental valuation* has particular importance to extension programs dealing with natural resources. While all agricultural industries are dependant on a clean environment to produce goods, the forestry and fishery industries are especially reliant on these assets for economic output. These industries are further challenged to produce at sustainable levels to ensure future production. The SHARP logger program illustrates the forestry industry commitment of providing sustainable management strategies to sizes of operations. Moreover, stakeholders claim that many of the public volunteer programs have immense value in preserving natural resources. As industry views forestry and water resources as profits and products, communities can perceive these assets as part of their heritage or as social amenity. Thus, this perspective provides a different value to the economy that had not previously been recognized.

*Business attraction* has been cited by industry as an unintended effect of Agency 229 investment. The pilot plant is labeled as a ‘collision space’ for industry and researchers to meet and jointly develop products. There are several instances of West Coast beverage companies collaborating with 229 researchers at the facility. While the initial purpose of the research was to evaluate the company’s current manufacturing processes, researchers also provided testing and analysis of regional water availability and suitability for beverage production. Two such companies have since announced plans for expansion in Virginia, investing over \$100 million and creating 150 jobs. They attribute at least part of their decision to the 229 facility and research collaboration and workforce training opportunities.

Industry cited the strength of the talent provided by the University’s degrees as another selling point to staying in or moving to the state. Ultimately various reasons influence a company



## DEVELOPING A HOLISTIC ASSESSMENT FOR LGU EI STUDIES

to choose any location, and some indicate Agency 229 played a substantial role in the decision. For instance, safety validation conducted jointly by extension faculty and company-researchers, led to an expansion of a facility by 200 additional jobs support an additional product line. Attribution becomes vague in many cases because not all instances of collaboration will lead to as strong as an endorsement.

**Public Health** impacts are a common theme across VAES and VCE. Animal health, safe handling of food training, and testing foods products for food companies all protect the food system. For example, vertically integrated facilities are highly vulnerable to disease, as animals are housed in close proximity to each other. Disease prevention programming is essential in mitigating the cost of disease outbreak. VAES representatives were part of the Virginia Poultry Disease Taskforce, which was implemented during the 2002 Avian Flu Outbreak that led to losses of more than \$230 million in Virginia alone. The taskforce developed and implemented an industry-wide policy for dealing with disease, and continues to conduct disease surveillance. Agency 229-developed protocols are now incorporated in a larger system used by the USDA to track outbreaks and help mitigate losses for industry and farmers alike. This activity is indispensable for the sustainability of the industry and the state-wide economy, however again the direct attribution for VCE is unclear and in any given year VCE protocol's could prevent an outbreak. Moreover, by preventing future losses of hundreds of millions of dollars, VCE activities encourages the poultry industry to continue to invest in Virginia. Food safety is also critical to people's continued health and welfare, and mitigating those risks prevents economic losses which can be measured by a worker's lost productivity.

**Workforce Development** has long been a critical component of extension programming. Certification programs such as those held at the Agency 229 meat processing building or

## DEVELOPING A HOLISTIC ASSESSMENT FOR LGU EI STUDIES

ServSafe® Training for food workers allows employers to reduce training cost and improves the quality of service businesses are able to provide. These cases provide an easy metric for valuation, as extension tracks the number of participants and industry know the costs of training. However, industry highlighted that Agency 229 effects workforce development through human capital development with far reaching returns over the long-term. Food and Beverage industry representatives indicated that the graduates of the Food Science Program are especially valued because of their real world experience alongside researchers in Agency 229 facilities. Projects held at the pilot plant or classes at the meat processing facility provide experiences not seen at other peer Universities. From an economic evaluation perspective, the authors asked, does Agency 229's VCE efforts add a premium to education the University offers? Another well known VCE program that impacts workforce development is 4-H. 4-H programming emphasizes 'learning by doing' models of education, with a key component of fostering youth leadership and teamwork skills. Community stakeholders in Washington County for example, expressed the county's program resulted in students to be better prepared for school activities and felt employers valued the development of professional skills learned in the program. That program boasts 4,000 child and teenage participants. Nationally, 4-H is the most researched extension program with substantial positive evidence of impact on youth behavior (Lerner et al., 2005). However, there is scarce evidence on the economic value this program generates, partly because industry and employers value these significant outcomes differently than do parents and community members.

*Unbiased information* from VAES researchers and VCE agents was a common highlight in discussion with both Industry experts and producer association representatives. Agency 229 acts as an information broker providing Industry with producer feedback, while acting as a

source of trusted information on latest technologies and practices for farmers. For instance, varietal improvement research in row crop programming is conducted at ARECs and demonstrated to producers and industry during field days; field days often take place on private farms after researchers have collaborated with producers. This on-farm research allows producers to work closely with VCE agents and specialists to better understand growing conditions, risks, and best management practices. Participating producers are the first to see the benefit of adopting a new variety; however, they also aid extension and disseminate this information the fellow farmers. These on-farm trials are a critical part of encouraging farmers to adopt improved varieties and environmentally friendly management techniques, leading to large-scale economic benefits. Part of field day programming is supported by private industry. This relationship provides two-fold benefits to the industry, first by providing research that leads to increases in yields and profits, and second by providing mechanism to better understand the needs Virginia producers who are a vital component of industries' supply chain.

### **Discussion and Conclusion**

VCE agents interviewed for this study see their role as critical for continued economic and community growth. They often struggle to communicate their influence in economic terms and often are not sure about how to use impact statements to convey their work. Almost universally, agents express frustration when it comes to economic impact calculations. Some agents desire new methods and additional evaluation personnel to assess the extent to which technologies or programs were adopted, and the ways in which those programs influenced the economic situation of stakeholders. Others express frustration in distilling the value they provide to communities to a single number. Agency 229 researchers also expressed a similar frustration in calculating the impact of their efforts in economic terms because the purpose of their efforts is

## DEVELOPING A HOLISTIC ASSESSMENT FOR LGU EI STUDIES

not economic growth, but knowledge creation and social betterment. Interestingly, this lack of quantitative evidence was largely irrelevant to the external stakeholders: private industry, commodity associations, and community leaders.

Industry and commodity association representatives confirmed many of the impacts projected by the agency's administration. However, these were not the only impacts perceived by these stakeholders. Often, these ancillary effects support the producers who comprise the supply chains of large companies. On a case by case basis, the impacts look small and may allude to why they are not tracked. Alternatively, the value of the service depends on the stakeholder; producers rely on extension assistance to maintain their livelihoods while companies may view the same assistance as a reduction in costs. Both valuations are essential to the economy, however differ greatly. Moving forward, as agents are asked to provide self-assessments of their work, extension should aim to incorporate input from the different external stakeholders they serve. Impact statements are not invalid, however would benefit greatly from industry, communities, and commodity associations inputs.

Data gathered and analyzed from over 4000 impact statements and 200 stakeholders affirm the findings of Joly et.al. (2014), that the impacts of LGU agricultural and natural resource extension and research are vast and diverse and difficult to calculate and distill into one economic impact number. The process of identifying attributions is complicated by the myriad of impacts Agency 229 and the indirect effects created by a majority of the agency's program. In addition, the end users of Agency 229's activities - private industry and communities - describe different economic values overlooked in current extension reporting and programming. In fact, these impacts collectively compliment innovation and productivity gains described by 229 administration and lead to a more robust and diverse Virginia economy.

## References

- Anderson, J. R., & Feder, G. (2004). Agricultural extension: Good intentions and hard realities. *The World Bank Research Observer*, 19(1), 41-60. Available at <https://academic.oup.com/wbro/article-pdf/19/1/41/4729522/lkh013.pdf>.
- Ambargis, Z., Mead, C. I., Rzesnik, S. J., Swenson, D., & Weisenberger, J. (2014). Economic Engagement Framework: Economic Impact Guidelines. Washington, D.C.: *Association of Public and Land-Grant Universities*.
- Association of Public and Land-grant Universities (APLU) (2014) Economic Engagement Framework: New Metrics Field Guide. Washington, D.C.: *Association of Public and Land-Grant Universities*.
- Barlow, Z., Davis, L., Greiner, L., Key, L., Loeffler, A., Sudol, J., & Sutphin, M. (2016). *Partners in Progress: 2016 Agency 229 Annual Report*. T. Glidden (Ed.) Blacksburg, VA: Virginia Tech.
- Chatterjee, D., Dinar, A., & González-Rivera, G. (2016). *The Contribution of the University of California Cooperative Extension to California's Agricultural Production*. Riverside, CA: Department of Environmental Sciences, School of Public Policy, Department of Economics, University of California, Riverside. Retrieved from <https://spp.ucr.edu/publications/contribution-cooperation-extension.pdf>
- Diem, K. G. (2003). Program development in a political world--It's all about impact. *Journal of Extension*, 41(1). Retrieved from <https://www.joe.org/joe/2003february/a6.php>
- Donaldson, J. L. (2014). *Adancing Tennessee: Statewide Economic Assessment FY 2014*. Knoxville, TN: University of Tennessee Extension, Institute of Agriculture. Retrieved from: <https://extension.tennessee.edu/eesd/Documents/PlanningEvaluation1/EconomicAssessment/FY2014UTEExtensionEconomicAssessmentDescriptions.pdf>
- Drucker, J., & Goldstein, H. (2007). Assessing the regional economic development impacts of universities: A review of current approaches. *International regional science review*, 30(1), 20-46.
- Franz, N. K. (2013). Improving Extension programs: Putting public value stories and statements to work. *Journal of Extension*, 51(3), 3TOT1-None. Retrieved from <https://www.joe.org/joe/2013june/tt1.php>
- Hutchinson, W. G., Chilton, S. M., & Davis, J. (1995). Measuring non-use value of environmental goods using the contingent valuation method: Problems of information and cognition and the application of cognitive questionnaire design methods. *Journal of Agricultural Economics*, 46(1), 97-112.

## DEVELOPING A HOLISTIC ASSESSMENT FOR LGU EI STUDIES

- Kalambokidis, L. (2014). Creating public value with tax and spending policies: The view from public economics. *Public Administration Review*, 74(4), 519-526.
- Kalambokidis, L. (2011). Spreading the Word About Extension's Public Value. *Journal of Extension*. 49(2), 2FEA1. Retrieved from <https://www.joe.org/joe/2011april/a1.php>
- Kalambokidis, L. (2004). Identifying the public value in Extension programs. *Journal of Extension*. 42(2), Article 2FEA1. Retrieved from <https://www.joe.org/joe/2004april/a1.php>.
- Kalambokidis, L. (2003). *Identifying the public value in Extension programs*. Department of Applied Economics, College of Agricultural, Food, and Environmental Sciences,
- Lerner, R. M., Lerner, J. V., Almerigi, J. B., Theokas, C., Phelps, E., Gestsdottir, S., ... & Smith, L. M. (2005). Positive youth development, participation in community youth development programs, and community contributions of fifth-grade adolescents: Findings from the first wave of the 4-H study of positive youth development. *The Journal of Early Adolescence*, 25(1), 17-71.
- Lewis, D. (2013). *Counterfactuals*. John Wiley & Sons.
- O'Neill, B., & Richardson, J. (1999). Cost-benefit impact statements: A tool for Extension Accountability. *Journal of Extension*, 37(4), 4. Retrieved from <https://www.joe.org/joe/1999august/tt3.php>
- O'Neill, B. (1998). Money Talks: Documenting the Economic Impact of Extension Personal Finance Programs. *Journal of Extension*, 36(5), n5. Retrieved from <https://www.joe.org/joe/1998october/a2.php>
- Sirmans, S., Macpherson, D., & Zietz, E. (2005). The composition of hedonic pricing models. *Journal of real estate literature*, 13(1), 1-44. Retrieved from <https://search.proquest.com/docview/200098809?pq-origsite=gscholar>.
- Tietenberg, T. H., & Lewis, L. (2016). *Environmental and natural resource economics*. Routledge.
- University of Maine (2007). Welcome to Cooperative Extension: Maine Wild Blueberries. Orono, ME: Cooperative Extension. Retrieved from <https://extension.umaine.edu/blueberries/>
- Vardakoulias, O. (2013, April). Valuing the environment in economic terms. London: New Economics Foundation (nef). Available at <https://www.nefconsulting.com/wp-content/uploads/2014/10/Valuing-the-environment-in-economic-terms-briefing.pdf>
- Jin, Y., & Huffman, W. E. (2016) "Measuring Public Agricultural Research and Extension and Estimating their Impacts on Agricultural Productivity: New Insights from US

- Evidence, "Agricultural Policy Review: Vol. 2016: Iss. 1, Article 3. Available at:<http://lib.dr.iastate.edu/agpolicyreview/vol2016/iss1/3>
- Joly, P. B., Colinet, L., Gaunand, A., Lemarié, S., & Matt, M. (2016) Agricultural research impact assessment: issues, methods and challenges. [Research Report] auto-saisine. 51. Retrieved from: <https://hal-sde.archives-ouvertes.fr/hal-01431457/document>
- Joly, P. B., Gaunand, A., Colinet, L., Larédo, P., Lemarié, S., & Matt, M. (2015). ASIRPA: A comprehensive theory-based approach to assessing the societal impacts of a research organization. *Research Evaluation*, 24(4), 440-453.
- Maru, Y., Sparrow, A., Stirzaker, R., & Davies, J. (2016). Integrated agricultural research for development (IAR4D) from a theory of change perspective. *Agricultural Systems*. Retrieved from: <http://www.sciencedirect.com/science/article/pii/S0308521X16305443>
- Nguyen, H. N., Van De Fliert, E., & Nicetic, O. (2015, February). Beyond economic impact: towards a holistic framework for impact assessment of agricultural research for development in remote and culturally diverse regions of Vietnam. In *59th National Australian Agricultural and Resource Economic Society (AARES) Conference*.
- Norton, G., & Davis, J. (1981). Evaluating Returns to Agricultural Research: A Review. *American Journal of Agricultural Economics*, 63(4), 685-699. Retrieved from <http://www.jstor.org/stable/1241211>
- Rao, X., Hurley, T. M., & Pardey, P. G. (2014). Re-examining the reported rates of return to food and agricultural research and development. *American Journal of Agricultural Economics*, 96(5), 1492-1504. Retrieved from: [http://ageconsearch.umn.edu/bitstream/135018/2/RaoEtAl2012\\_v2.pdf](http://ageconsearch.umn.edu/bitstream/135018/2/RaoEtAl2012_v2.pdf)
- Zumeta, W. (1998). Public university accountability to the state in the late twentieth century: Time for a rethinking?. *Review of Policy Research*, 15(4), 5-22. Available at <http://www.worldcat.org/title/public-university-accountability-to-the-state-in-the-late-twentieth-century-time-for-a-rethinking/oclc/81573412>