

INSIGHT BRIEFS from

The Value Chain of Colorado Agriculture



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February 2013



Colorado State University

Acknowledgments

This project was made possible by support from the Colorado Department of Agriculture and the Colorado State University Office of Engagement. The authors would like to thank Tom Lipetzky and Timothy Larsen of the Colorado Department of Agriculture, James Pritchett, Christopher Goemans, and Norman Dalsted of the CSU Department of Agricultural and Resource Economics, as well as Jim Beers, Bridget Julian, and Lou Swanson of the CSU Office of Engagement, and members of the CSU President's Ag Advisory Council for helpful comments and feedback at various points in the development of this study. All remaining omissions and errors are the responsibilities of the authors.

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Recommended citation: Graff, Mortenson, Goldbach, et al, *The Value Chain of Colorado Agriculture*, Department of Agricultural and Resource Economics and the Office of Engagement, Colorado State University, February 2013.

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Conclusions and Implications from the Food and Agriculture Value Chain for the Development of the Colorado Economy

This value chain analysis identifies and maps the structure of Colorado's agriculture and food industries. Economic value is created within five broad segments along the value chain—(1) agricultural inputs, (2) primary agricultural production, (3) agricultural output marketing, processing, and manufacturing, (4) wholesaling, and (5) retailing. Value also arises that is not captured in markets. Within these five broad segments of the value chain, more than 125 distinct economic activities, sub-sectors, and/or specific industry classification (NAICS) codes have been considered.

This value chain analysis is intended to assist in efforts to engage agriculture more deeply in the state's strategic planning and investments in economic development. While all 125 sub-sectors that make up the agriculture and food value chain are unlikely to fully agree, our research focused on shared opportunities for Colorado agriculture within the framework of six core objectives for economic development, articulated by the Office of Economic Development and International Trade (OEDIT) in the *Colorado Blueprint* initiative. These six core objectives represent areas with a greater degree of shared interests across the key industries of the state. These statewide core objectives are to:

- Build a business-friendly regulatory environment;
- Recruit, grow, and retain companies;
- Improve access to capital;
- Create and market a stronger "Colorado" brand;
- Educate and train the workforce of the future; and
- Cultivate innovation and new technologies.

We conclude here with reflections and implications drawn from the full value chain analysis for each one of these six core objectives.



Photo courtesy of Dan Hilleman, Professor Emeritus, Colorado State University

1. The Regulatory Environment for Food and Agricultural Businesses in Colorado

This analysis of the value chain of Colorado agriculture finds a surprisingly wide scope, with over 125 separate sectors woven together in a variety of supplier-customer and competitor-collaborator relationships. Both in terms of breadth and length, the value chain that leads from agricultural inputs all the way to a satisfying meal is complex. It intersects and integrates with many different parts of the state, national, and global economies. As a result, the value chain of Colorado agriculture cuts across a wide range of local, county, state, and federal regulations, and even the terms of international agreements to which the U.S. is party.

We can highlight several regulatory hotspots of particular importance to those who operate within this value chain:

Environmental quality: The natural resource footprint of agriculture is necessarily quite large, and this fact inevitably exposes the industry's value chain to a wider range of state and federal environmental regulations than most other industries.

Water rights: The crucial importance of water to the creation of value along the value chain—from growing crops to the manufacture of beverages—braids the industry's fate tightly with the regulation of water rights and water markets.

Worker safety: Working conditions along the value chain are wide ranging, highly variable, and sometimes physically risky—whether in the field, in the feedlot, in the slaughter plant, in the bottling plant, or in food service and retail—invoking a wide range of employment and worker safety regulations.

Immigration and labor: The agriculture value chain encompasses a broad spectrum of job types, including lower wage labor positions that often can only be filled by individuals from other cultural backgrounds, forcing employers up and down the value chain to directly deal with immigration and labor regulations on a regular basis.

Animal welfare: Regulatory issues range from the interface of agriculture and wildlife, to the genetics of livestock, veterinary treatments of livestock, living conditions, diet and feed composition, slaughter, and processing.

Food safety: Standards governing safe handling, pathogens, genetic modification, and more affect both crop and livestock agriculture, and affect the options of input providers, food manufacturers, and retailers alike.

With so much complexity and with requirements for compliance on so many facets, red tape issues are endemic to the value chain of Colorado agriculture. There is a distinct advantage to operating at larger scale. Professional technical and legal review can be made of all aspects of the operation in establishing production routines to assure regulatory compliance in the most efficient way possible, and scale allows for those costs of compliance of to be spread out over more units of production. The result is one of systemic bias against smaller businesses and new startups. Another result is a bias against innovations—whether organizational innovations, technological innovations, or new product innovations—because of the costs of adapting regulations to accommodate new products or new methods of production adds to the costs of introducing those innovations.

Given the very large populations of small scale farms, as well as the challenges of starting small food businesses, proposed cottage industry reforms to create workable standards for small-scale agribusinesses have the potential to affect the largest segment of the population of operations at multiple points in the value chain. They also offer to foster product innovation, experimentation with novel business models, and even the emergence and growth of new sectors.

2. Workforce Development Needs and Opportunities along Colorado's Food and Agriculture Value Chain

The breadth and length of the agriculture value chain creates a diversity of job types with requirements for a wide range of skills. Thus, a range of different types of job training or human capital investments could have an impact on the value chain of Colorado agriculture. From the beginning of the value chain with agricultural input, through farming and ranching, manufacturing, and the wholesale segments, the value chain accounts for about 100,000 jobs, excluding retail. The retail sectors considered in this analysis—including food sales, food service, pet supply, garden and nursery, and landscaping sectors—together account for an additional 300,000 jobs.

Employment Patterns: Several important employment patterns can be noted from analysis of the value chain:

- Average wages tend to be the highest in the manufacturing and marketing segments of the value chain, where more of the jobs are in management, business administration, sales, and purchasing.
- In the farm and ranch sector, ownership and employment roles are complex, with the workforce falling into three main groupings—owner operators, hired employees, and contract workers. Many of those who work in agricultural production are highly entrepreneurial, playing multiple roles as both manager and skilled laborer. As a result, skill sets are diverse and, on average, earnings tend to be lower than other sectors.
- Professional careers throughout the agricultural value chain—whether in management, sales, engineering, or biosciences—do not require a background or explicit training in “agriculture.” Top talent can often be attracted from other industries.
- The retail segment of the value chain tends to be the most non-specialized in terms of job requirements, with an abundance of entry level food service and retail positions available. These jobs are often only remotely connected to other parts of the value chain, and offer less opportunity for training and development of skills transferrable to other segments of the value chain.
- A significant gender gap persists in all segments of the agriculture and food value chain except for retail.

Two broad job categories, low-wage workers and skilled workers, are prevalent at multiple segments along the agriculture value chain and may present higher impact opportunities for workforce development initiatives.

Low-wage Labor: The first category consists of low wage labor jobs, such as farmworkers and laborers, graders and sorters, hand packers, slaughterers and meatpackers, food batch makers, food service preparation workers, fast food cooks, dishwashers, food servers, and cashiers. Most of these jobs have earnings of less than \$10/hour.

Employers up and down the value chain can find it difficult to fill jobs that involve hard manual labor with American-born employees, particularly those that are physically demanding or dirty—such as hand harvesting in fields or working the line in slaughter plants. This inevitably leads to discussions about immigration issues and employment. Other possible avenues of discussion include innovation and automation to reduce demand for such labor over the longer run.

Skilled Trades: The second category is that of skilled tradespeople, such as agricultural equipment and heavy equipment operators, truck and tractor drivers, manufacturing equipment operators, equipment mechanics, and computer technicians.

The quality of training and the ability of those in the skilled trades to adopt and implement new technologies are particularly crucial for competitiveness as well as maintenance of safety and regulatory compliance. The prevailing educational system in the U.S. and the state of Colorado encourages more academic 2-year, 4-year, graduate and professional qualifications. This means that fewer skilled tradespeople are available in the range of physically demanding production and transport settings common to the agricultural value chain.

Further workforce analysis would be required to verify these trends and to consider what sort of training opportunities could maximize agricultural and food industry employers' ability to fill such positions. Given that workers can find multiple points of entry into Colorado agriculture, a solid K-12 educational foundation and the expectation of life-long learning to develop additional skills as agriculture continues to grow will be critical to the industry's future.

3. Implications for the Creation and Retention of Agricultural and Food Businesses in Colorado

The structure of the value chain suggests several factors that may govern decisions to create, locate, or keep an agricultural or food business in Colorado. The current makeup of the industry is by no means arbitrary. Physical and geographical factors were initially the most fundamental factors dictating the historical development of farming and ranching in Colorado. Homesteading and farming were initiated statewide, yet they succeeded and persisted in those locations where conditions proved to be most productive and profitable. Transportation infrastructure—roads and railroads—was constructed where it was most advantageous to move increasingly abundant products to market. Then, given the existing mix of primary productivity, transportation infrastructure, and growing nearby populations, supply and processing industries emerged to service and create further value from the commodities coming out of the farm and ranch sector.

Some of these original factors will continue to shape the growth of economic activity up and down the value chain.

Availability of Land and Water: Rapid urban growth, real-estate development, and the expansion of a rural-urban interface, especially given the geography of the state's urban growth, create both opportunities and challenges. This is especially true of the Front Range urban corridor, where urban development coincides with some of the best agricultural lands in the state, but it is equally true in many of the mountain valley and Western Slope communities, if perhaps on a smaller scale. Land use planning and zoning as well as the mechanisms for efficient allocation of water use become key issues for agricultural businesses seeking to continue and even expand operations, while at the same time taking advantage of proximity to an increasingly urban population as both workforce and customer base.

Unmitigated buyouts of land and water assets for non-agricultural uses (and the converse: the opportunistic sell-offs of land and water assets by agriculture) creates incentives and dynamics for agricultural businesses to leave a region. The first assets to be sold off are those used for lower-value field crop and forage production. This will then drive

up costs for nearby livestock and dairy producers. Resulting decline in primary agricultural production weakens the key link in the value chain, and weakens economic conditions for service and input providers, as well as marketing and processing. Food and beverage manufacturers may continue to import commodities from other regions, but locational incentives are reduced.

There are some niche segments of the agricultural value chain that have significant growth potential—such as high-value, small-scale, “locally grown” fresh produce, vineyards and wine production, and freshwater aquaculture. A number of these sorts of operations are being started within or integrated into urban and suburban settings. Success of such urban agribusinesses hinges on clear and careful management and allocation of land and water resources. Their success can result in a greater quality of life for their urban resident neighbors, as well as in direct economic benefits of job creation and commercial activity.

Transportation Infrastructure: Transportation is still a key factor for the location and growth of economic activities that depends upon the movement of significant tonnage. This remains acutely true for those segments of the agriculture value chain that move large volumes, including major crops and livestock.

Quality of Life/Quality of Workforce: Executives of smaller high technology firms servicing agriculture—including biotechnology, crop genetics, and animal health firms—report that their decisions to locate head offices and operations in Colorado have hinged upon the ability it gives them to recruit and retain top talent. In today's world, with greater freedom of choice, human capital tends to gravitate to locations where the combination of career opportunity, community, and recreation coincide to create a high quality of life. Colorado's quality of life—with its combination of natural beauty, favorable climate, livable communities, and outdoor recreation opportunities—is attractive. Top businesses want, and even need, to be located where a talented workforce wants to live. This is just as true for agribusinesses as it is for software, biotech, or design firms.

A Business Culture Where Small is Beautiful Too: We see significant size imbalances across the population of firms—between large-economies-of scale operations and smaller niche operations—in more

than one segment of agricultural value chain. It is especially visible in the farm and ranch sector, but it can also be seen in marketing and processing as well as in food retail. Given these extremes, it is understandable that a cultural divide exists between the big and the small. It is also natural for larger businesses to become consistently engaged in policymaking, such that their voices are more loudly and regularly heard, resulting, over time, in policies that tend to favor their scale of operations.

However, a large population of small businesses within a sector creates an abundance of opportunities for business-model experimentation and innovation. These segments of the agricultural value chain with large numbers of small businesses present such an opportunity, assuming that the business culture and policymakers do not sideline them as merely “hobby” farms or “mom-and-pop” businesses. Taking small businesses seriously and creating the right conditions—such as appropriately balanced regulations and access to finance—can enable the more successful ones to grow larger. Locally-founded businesses, particularly those in food and agriculture, are more likely to stay in Colorado and be committed to the success of the region.

Toward Critical Mass in Four Emerging Agricultural Clusters

Some aspects of agricultural production are inevitably spread out and diversified. However, opportunities for development often arise under conditions where a virtuous cycle of growth in an industry, often called “clustering,” attracts a critical mass of operations and human capital creating a vibrant “ecosystem” within a particular geographic region. Such an ecosystem then attracts firms to relocate there in order to enjoy the competitive advantage of being part of the cluster. The ecosystem itself also spawns new firms, as managers and workers who at existing firms and can see new needs emerging set out as entrepreneurs. Their chance of success is greater, since they are already tightly networked with former colleagues, suppliers, and customers within the region. In fact, geographical proximity is a key factor for the formation of an industry cluster. Examples of clusters in agriculture include the California wine industry, centered in Napa Valley, and the New Zealand wool industry. Both encompass relatively small geographic regions.

Based on our analysis of the existing value chain of Colorado agriculture, there appear to be (at least)

four regional clusters in Colorado agriculture, each with a different specialization:

- **Northeastern Colorado/South Platte River Valley Commodity Crop and Livestock Cluster:** The first and largest agricultural industry cluster in Colorado consists of the intensive feed crop production, livestock feeding, meatpacking, and dairy production along the South Platte River and Republican River valleys.
- **San Luis Valley Cluster:** The second agricultural cluster is centered the San Luis valley, with regional specialization in higher-value cold climate vegetable crops, including potatoes, onions, and beans, as well as some concentration of feed grains and forage production and some livestock.
- **Western Slope Fruit and Vegetables Cluster:** The third cluster is located on the Western Slope along the Colorado, Gunnison, and Uncompahgre River valley system, roughly encompassing the cities of Fruita, Grand Junction, Palisades, Delta, Olathe, Cedaredge, Hotchkiss, and Paonia. This region specializes in fruit and vegetable growing, such as Palisade peaches and Olathe sweet corn, and includes the state’s two main viticultural regions. But, outside of wine production, this region has limited processing and manufacturing.
- **Northern Front Range Natural, Organic, and Local Foods Cluster:** The fourth, still emerging cluster is characterized by a combination of mixed cropping and food manufacturing. It is more integrated with the urban and suburban environment, being located in essentially the quadrangle between Denver, Boulder, Fort Collins, and Greeley. Perhaps as a result of this more populous, urbanized location, or because of the greater weight of food manufacturing and direct-to-consumer retail, this cluster is more oriented toward consumer preferences, with, for example, a higher proportion of organic and “local” food sales.

These four regions have many of the essential elements of economic clustering, involving several segments of the value chain. While, the first of these four can be considered a mature cluster, with a critical mass of firms up and down and a fully developed value chain, the others still present major opportunities for transformative growth. As they mature, the economic ecosystems of these clusters could themselves become a driving force behind the creation and retention of agricultural and food businesses in Colorado.

4. Access to Capital for Agricultural and Food Businesses in Colorado

In this analysis we have seen that, for the farm and ranch segment of the value chain, access to capital is not a problem. The U.S. farm credit system works, and debt burdens are at a historic low.

The U.S. farm credit system consists of a blend of federal, state, cooperative, and private financial institutions. The USDA makes, or at least backs, many of the loans to qualified agricultural borrowers. And all the institutions within the system, or their agricultural lending divisions, understand the farm sector and its risk structure. Given this specially adapted and time-tested system of finance, farms are in a somewhat unique position as borrowers.

We also note recent analysis by the USDA (Harris et al, USDA-ERS, 2009) that, nationally, farms and ranches are using less than a third of their debt repayment capacity. So naturally, commercial lenders are looking at farms as a good opportunity.

What is less apparent, however, is the extent to which capital constraints are an issue for business investments elsewhere up and down the value chain. If so, such a situation could be problematic even for farms and ranches awash in easy credit. If suppliers or customers, up and down the value chain, are unable to make investments, to upgrade, to innovate, or to grow, this could constrict and retard the growth of the value chain as a whole.

Outside of the farm and ranch sector, it is necessary for businesses to turn to commercial banking divisions of the lenders. When a straightforward investment case can be made, getting a commercial loan or line of credit is not an undue difficulty. Small businesses may qualify for SBA loans, and entrepreneurs can pitch high-risk, high-growth opportunities to venture capital. There are, however, some potentially major challenges that, if solved, could be transformed into major opportunities for Colorado.

The first major set of challenges/opportunities lie in overcoming broad differences in investment cultures. Differences are seen between at least three investment cultures:

- Agricultural production and manufacturing investments, based on collateral assets including farm land or physical plant.

- Retail business services or branded products, which are higher risk and much more dependent on human resources and marketing.
- Technology based investments, such as in the biosciences or in software applications, which are much higher risk and largely based on intellectual property and/or regulatory requirements and approvals. Payback is largely determined by rates of adoption of the technology in primary industry sectors, such as crop production, feedlots, or food manufacturing.

Financing terms and investment deal structures will vary greatly among these different investment cultures. Those with expertise and a comfort level making investments within one environment may need training or collaboration with more experienced partners in order to participate in investments in another.

A second major set of challenges/opportunities is due to the vertical complexity of the value chain and crafting investments when a new business opportunity spans two or more links in the value chain. It may be more difficult for lenders or investors to assess the value of new investments. Commercial bankers familiar with more routine businesses, even in the food service or food product manufacturing sectors, may feel uncomfortable or out of their depth if a deal involves production agriculture. Crucially, however, this is precisely the space in which some of the most interesting and valuable investments for growing the value chain need to be made.

For some of the most interesting and important projects, entrepreneurs and their investors will find they need to cobble together funding from multiple sources, both to share risk and to pool the expertise of various lenders. Such deals, unfortunately, can be complex and tricky to negotiate.

Historically, this was a role that was played institutionally, at least to some extent, by co-operatives. They were often mechanisms for coordinating investments spanning different segments of the value chain. For example, growers might come together and pool their savings in order to invest in a processing facility. In so doing, they would become "members" (i.e., shareholders) of the co-operative. In recent years, however, co-operatives have been in decline, as corporate legal structures have become preferred.

5. Developing a Brand Reflecting the Qualities of Colorado Agriculture, Food, and Beverage

What is “Colorado” cuisine? What is the quintessential “Colorado” dining experience? Analysis of the value chain reveals the state’s established and emerging strengths when it comes to production of agricultural, food, and beverage products, and thus what Colorado may potentially boast of doing biggest and best. However, we may need to look more closely to find suggestions for a refreshing and memorable communication of the qualities or the style that defines “Colorado.”

While the “Colorado Proud” campaign has become widespread within the state, it faces a couple of natural limitations. First, it was designed and deployed as a region-of-origin label, a general designation somewhat akin to the label “organic.” Generally speaking, region-of-origin labeling of food products has proven most memorable when a region’s name is associated with one particular product, such as Champagne’s sparkling white wines, Thailand’s rice, or New Zealand’s wool. Any brand association with a region’s name gets increasingly diluted as it becomes applied across multiple food categories. As such, a geographic designation is not really that well suited as a brand. And, to the extent that it is effective, it is likely to appeal much more to the 5.1 million consumers that call Colorado home than to consumers outside the state. In Kansas, the phrase “Colorado Proud” probably just does not have the same ring.

This leads to the question of what might be more broadly appealing—nationally or internationally—about the character or the qualities of Colorado that can be associated with our food and agricultural products. What is uniquely “Colorado” that food and agricultural businesses up and down the value chain would want to identify with?

A branding that is honest to the scope of Colorado food and agriculture would need to bring together the bounty of the plains and the fruits of the mountains. It also would need to span large scale commodity production systems and the emerging quality-obsessed “foodie” culture of Boulder, Denver, and the mountain resort towns. The value chain may provide ideas for images suitable to promoting Colorado. For example:

- Water fresh from the Rocky Mountains
- The golden plains
- Grade A beef from the western range
- Mountain raised lamb
- Fresh caught trout
- Seasonal produce of unique quality due to unique conditions of altitude, temperature, sun, or water, including Olathe sweet corn, Palisade peaches, and Rocky Ford melons
- Craft brewed beers

A Colorado brand in agriculture and food might invoke or impart a range of qualities associated with a Colorado quality of life, such as:

Real. Innovative. Hip. Relaxed. Outdoors. Natural. Healthy. Rugged. Fun.

6. Innovation and New Technology in the Food and Agriculture Value Chain

The structure and contours of the value chain suggest several considerations for advancing innovation and new technology in Colorado agriculture.

Perhaps most fundamentally, given the length and breadth of the value chain, it would be naïve to expect that all of the innovation and new technology that gets put to work by Colorado food and agricultural enterprises comes from within the state. In fact, those Colorado businesses that are most globally competitive are inevitably those that are habitually scanning the horizon, seeking out, and bringing in state-of-the-art technologies from all around the globe.

Agriculture confronts a number of cross-cutting challenges and opportunities that are becoming increasingly acute in Colorado, but that are also being confronted in many parts of the world, including water scarcity, a growing urban-rural interface, livestock waste, infectious zoonotic diseases, crop genetics, and the organic and local foods movement, to name a few. Necessity is the mother of invention, but once solutions are found that work in Colorado—solutions that push technology or practice to new levels—it can be expected that others around the world will look to Colorado and seek to emulate its innovations. Thus, the opportunities and benefits presented by tackling such cross-cutting globally-relevant challenges are not limited to Colorado. The market for such innovations is global.

The geography of the value chain may hold another key to the potential for innovation in food and agriculture in Colorado. The state's greatest concentration and diversity of agricultural production and processing are proximate to the state's main urban areas along the Front Range. While this proximity presents many challenges and conflicts, it also presents opportunities and resources. It means proximity to the state's main research institutions, to a bulk of technology companies with expertise in everything from biotechnology, to computers, to advanced engineering. It also means proximity to the Front Range's critical mass of top talent, attracted to Colorado for its quality of life. This overlap of agriculture on a significant scale and scope and a high-tech urban corridor holds all of the ingredients necessary to spawn an innovation cluster. There are only a few regions in the western U.S. with a comparable confluence of agriculture, research, and

urban resources, with the others the northern California Central Valley around Davis and Sacramento, central Iowa around Ames and Des Moines, and perhaps the central Texas region around College Station, Austin, and Houston.

The vertical complexity of the value chain, in most areas of agriculture, poses one of the greatest challenges to innovation in agriculture. Some of the most game-changing technologies may actually require vertical coordination among multiple segments of the value chain. One recent example of this is the development of the Ultragrain® program by ConAgra, the Colorado Wheat Growers, and Colorado State University, with the latter providing the new genetics, and the wheat growers agreeing to contract with ConAgra to produce and deliver identity-preserved crops consisting of CSU's novel wheat varieties. Often, such vertical coordination is achieved via vertical integration, when a supplier acquires one or more of its buyers. There are certainly sectors of the value chain where there is opportunity for implementation and adoption of new technology but where there is not an economic reason for full vertical integration. In such cases, the main questions regarding new technology are not technical, but rather economic and strategic.

Colorado clearly has areas of excellence in which it is a global leader in technological innovation. Our review of patenting activity (see section "Patenting by Colorado Inventors in Agricultural and Food Technologies") shows that such areas of excellence, not surprisingly, tend to overlap with areas where the industry's value chain is particularly strong. We also see that Colorado's public sector research institutions—particularly Colorado State University, University of Colorado, and the National Renewable Energy Laboratory—are prominent sources of innovation for the food and agriculture value chain, representing both broad seed beds of new ideas as well as practical partners for deeper exploration into key areas of technology along with Colorado businesses. R&D investments—both public and private—that build upon existing areas of strength, or that seek to build up new areas closely or strategically related to areas of existing strength, also represent logical opportunities.

One of the greatest potential strengths may lie in the confluence between the agricultural and medical biosciences. Some of this hinges on the large-animal veterinary expertise and livestock industry. Other aspects derive from the significant investments in

federal laboratory and state university infrastructure, but most important are the sometimes-thriving, sometimes-struggling crop of small and medium sized biotechnology firms located up and down the Front Range. The expertise being developed in a range of technologies—from regulation of genes, to disease mechanisms, to the engineering of useful biomolecules—are of potential value as either medical applications or agricultural applications. One insight that needs to be embraced by policymakers, managers, and especially investors is that sometimes a new biotechnology may be worth more in an agricultural application than it would in medicine. Yet, biotechnology often confronts the challenge that the creation of value in agriculture may depend upon coordination, with multiple segments of the value chain—such as farmers and processors, or crop and livestock groups—working together to adopt and implement the innovation. The key to success is dialogue and leadership that is able to envision and creatively manage emerging innovation opportunities.

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**PDF files of the complete study, executive summary, and key insights are online at
www.outreach.colostate.edu**

A video of Dr. Graff presenting this study to CSU Extension agents on March 15, 2013 is online at

<http://youtu.be/tmS-19Oefag>