

EXECUTIVE SUMMARY

The Value Chain of Colorado Agriculture



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Cover photo courtesy of Dan Hilleman, professor emeritus, Colorado State University Extension.

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Ryan Mortenson is a research associate in the department of Agricultural and Resource Economics at Colorado State University where he recently completed his Masters of Science with a research focus on the economic value of wheat variety development. His latest work is focused on business indicators assessing the competitive environment for agribusinesses in Colorado. As a native of Utah, Ryan feels almost at home next door in Colorado.



Dr. Rebecca Goldbach is a lecturer in the department of Agricultural and Resource Economics at Colorado State University where she recently completed her Ph.D. on natural resource management decision making. Dr. Goldbach teaches courses in microeconomics and agricultural marketing. She also serves as the Colorado Community and Economic Development Assistance Coordinator for the department to serve as a liaison with state agriculture, natural resource, and community development groups. Becky and her fiancée enjoy gardening and cooking.



Dr. Dawn Thilmany is a professor in the department of Agricultural and Resource Economics at Colorado State University. Dr. Thilmany's specialty is in the economics of value-added market differentiation of food products, such as local, organic, and specialty products. At CSU she teaches courses on agricultural finance, agricultural marketing, agribusiness management, and consumer demand theory. Having grown up on a farm in the Midwest, Dawn knows agriculture from the inside out.



Dr. Stephen Davies is a professor *emeritus* of the department of Agricultural and Resource Economics at Colorado State University and has recently taken up a post with U.S. Agency for International Development in Washington D.C. and Karachi, Pakistan. Dr. Davies' specialties include statistics, agricultural marketing and trade, and international and regional development. Married to an Italian, Steve has long had a penchant for world travel.



Dr. Stephen Koontz is an associate professor in the department of Agricultural and Resource Economics at Colorado State University. Dr. Koontz's specialty is market and price analysis and forecasting in commercial commodity agricultural markets, with a focus on cattle, forage, and grains. At CSU he teaches courses on agricultural marketing and econometrics. When not running the numbers, Steve shows a penchant for the high country, craft beers, and Girl Scout cookies.



Geniphyr Ponce-Pore is the Assistant Director of Community and Economic Development and is the Workforce Specialist for Colorado State University Extension. Ponce-Pore's specialty is building teams to develop and implement projects that address community, economic, and workforce development issues. Recent projects have included strategic planning for regional tourism, emerging workforce needs and developing next generation talent, small business development, and training to support new and seasoned entrepreneurs. Gen has also developed and runs a small all-natural body-care business with her daughter in Fort Collins.



Kathay Rennels is Assistant Vice President of Community and Economic Development at Colorado State University, she works with the Office of Engagement, Extension, and the Regional Economics Institute to advance collaborative networks across the state and create economic development opportunities. As a former county commissioner and state board representative, she has significant experience fostering public and private partnerships in regional and workforce development. Kathay grew up on a ranch in Colorado and continues to ranch with her husband northwest of Fort Collins.



Executive Summary: The Value Chain of Colorado Agriculture

Agriculture is one of the largest contributors to the Colorado economy and, in the words of Governor John Hickenlooper, “led Colorado out of the recession.” In 2012, agriculture was designated as one of the key industries in the *Colorado Blueprint* initiative for economic development. **For leaders in Colorado agriculture, the *Blueprint* provides a forum and opportunity to build bridges between the different commodities and communities that make up Colorado agriculture, including the closely associated food, beverage, and green industries, many of whom do not communicate regularly with one another.**

This value chain analysis is intended to serve as a common starting point for new conversations across the broad span of agricultural activities in Colorado. This analysis of the *Value Chain of Colorado Agriculture* supports the *Colorado Blueprint* initiative. It illustrates connections among disparate industries and sectors that nonetheless share common resources, constraints and opportunities. The information can aid in the formulation of industry, workforce, and economic development strategies. And, it can help to inform policy and regulatory decision-making processes.

Colorado Agriculture and the *Blueprint*'s Six Core Objectives for Economic Development

The *Colorado Blueprint* process identified **six core objectives for strengthening and improving Colorado's key industries:**

- **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**
- **Cultivate innovation and new technologies.**

Looking at the value chain of Colorado agriculture, in light of these six economic objectives, reveals numerous challenges and opportunities overlapping across its various industries and subsectors. For example, in many parts of the value chain, the availability and quality of both wage laborers and skilled tradespeople is crucial to the workforce of the

future. Also, Colorado has underexploited areas of excellence and global leadership in agricultural innovation, thanks in part to strengths in water resource management and in the interface between medical and animal biosciences. Also, Colorado's agriculture, food, and beverage can play a pivotal role in establishing the state's image as a brand and a destination for healthy living and active lifestyles.

Six briefs on the implications of the value chain for each of the six core objectives can be found in the conclusions section, at the end of this study.

Defining the Value Chain of Colorado Agriculture

The idea of a *value chain* refers to the series of steps or linkages that turn raw materials and other inputs into final products or services delivered to end users.

The *agricultural value chain* is defined as the flow of inputs and outputs that enable agricultural enterprises at the core of the value chain to realize the value of their unique capital base through sales, ultimately, of retail products to final consumers. For practical purposes, we have identified the core of the agricultural value chain to be that set of enterprises counted as farm and ranch operations in the 2007 USDA Census of Agriculture. The capital base of Colorado farms and ranches consists of the human capital, natural capital (land and water), physical capital (equipment, livestock and crop inventories), and financial capital owned by these operations. Each of the other sectors identified to be part of the Colorado agriculture value chain chosen because it has an economic link with farm or ranch operations. We follow the chain from inputs, through to outputs, including livestock, crops, and off-farm income, on to manufacturing and marketing, and ultimately down to revenue generated by Colorado retailers. In each section, key industry data is aggregated and explained.



Photo by Gregory Graff

The Upper Reaches of the Value Chain: Inputs to Agricultural Production

Inputs to agricultural production include productive capital—such as labor, land, water, equipment, genetics, and financing—as well as consumable inputs such as fertilizer, pesticides, electricity, and fuel. Annual expenditures by Colorado farms and ranches in each category represents an upper branch of the value chain, businesses and workers who create value by providing inputs to agricultural production.

Use of Capital Owned by Others: Payment of rent by Colorado farms and ranches to non-operator landlords for use of agricultural land was \$93 million in 2011. In recent years, annual fees paid by Colorado ranches to graze livestock on federal public lands are estimated at \$1.4 million per year. Annual rent paid by Colorado farms and ranches to non-agricultural water rights owners for use of their water is estimated to be at least \$40 million. In 2011, Colorado farms and ranches paid \$459 million in salaries, wages, and benefits to roughly 40,000 full time and part time on-farm employees. In 2011, agricultural equipment manufacturers sold an estimated \$236 million and farm and garden machinery dealers sold an estimate \$225 million representing investments by farm and ranch enterprises in their physical capital stocks. Also, in 2011, Colorado farms and ranches made interest payments of \$285 million (on principal of approximately \$3.5 billion) to maintain financing from private and public lenders.

On-farm Inputs: Some inputs, such as seed, feed, or young livestock, are by their very nature produced on farms. Thus, the value of expenditure by the farm or ranch that purchases them also counts as revenues for the other farm or ranch that sells them. In 2011, Colorado farms paid seed farms and seed companies \$196 million for seed. In 2011, Colorado livestock operations paid farms and feed mills \$1.46 billion for feed. Notably, feed prices have been growing in recent years: A decade ago, feed costs made up about 25 percent of Colorado livestock producers' total costs of purchased inputs; in 2011 they made up an estimated 37 percent. In 2011, Colorado livestock operations paid other livestock operations \$1.25 billion for live animals. Given the capacity of Colorado feedlots exceeds the supply of animals available from within the state, about two thirds of the cattle being placed on feed in Colorado are purchased from out of state and constitute "inshipments" to Colorado.

Manufactured Inputs: An additional class of purchased inputs consists of those originating from outside the farm sector, and thus suppliers of these inputs make up branches that are higher up the agricultural value chain. In 2011, Colorado farms paid \$310 million for fertilizers and \$113 million for pest control products. In 2011, Colorado farms and ranches paid fuel suppliers \$327 million for fuel and oil products, and they paid Colorado utilities and Rural Electric Associations \$161 million for electricity.

Services Procured: Farms and ranches also procure services. They paid \$276 million in 2011, mostly to local businesses and contractors, for repair and maintenance services. They paid \$63 million for machine hire and custom work, largely to other farms and ranches, as well as to specialized local businesses and contractors. Colorado farms and ranches paid \$33 million to contract labor companies for contract labor services. And they paid \$186 million in transportation, storage, and marketing expenses to trucking companies, grain elevators, and other such service providers.

Public Services: In order to support state and local services such as country roads, bridges, public weed and pest control, etc., taxes are assessed—in particular on those capital goods, such as land and vehicles that are associated with activities most likely to utilize and benefit from such public services. Thus, in 2011, Colorado farms and ranches paid \$184 million in property taxes and \$19 million in motor vehicle registration fees to county and state governments.

Insurance and Other Farm and Ranch Expenditures: Finally, Colorado farms and ranches paid an additional \$764 million designated to other "miscellaneous expenses," including expenditures on tools and supplies, miscellaneous livestock-related expenses such as veterinary care, business-related expenses, and insurance. In 2012, premiums paid to insurance companies for crop and livestock insurance totaled \$217 million. Federal crop insurance subsidies paid \$129 million of that total. Colorado farms and ranches paid the other \$88 million. Also, in recent years, Colorado farm and ranch operator households are estimated to be spending between \$106 to \$170 million on health insurance premiums and between \$73 and \$118 million in out-of-pocket health care expenses.

Down the Value Chain: The Outputs of Agricultural Production

Sources of revenue for Colorado farms and ranches totaled more than \$8.2 billion in 2011. These vary significantly, but each represents a vertical branch down the value chain, as that particular output or service provides an input for manufacturing or is marketed to final users.

Crops: The largest share of crop production in Colorado is devoted to crops intended for consumption by livestock. In 2011, Colorado farmers received \$1.4 billion for such feed and forage crops. Of that, \$911 million was for corn, \$380 million was for hay, and approximately \$100 million was for sorghum, millet, barley, and oats combined. A significant share of the feed crop harvest never leaves the operation where it was grown, a portion is sold directly to neighbors, and some enters more formal marketing channels. The high level of demand by cattle feeding and ethanol production accounts for virtually the entire corn grown in Colorado plus an estimated 80 to 90 million bushels shipped into the state each year.

Wheat is the primary food grain grown in Colorado, and was worth \$584 million in 2011. Oilseed production is smaller: In 2011, Colorado farms received \$43 million for production of oilseed crops, primarily sunflower. Particular regions of Colorado have proven favorable for fruit and vegetable crops. In 2011, Colorado farmers received \$250 million for potatoes, \$204 million for other vegetables, and \$32 million for fruits: making a total of \$485 million for all fruits and vegetables combined. Historically, sugar beets and sugar processing have played prominent roles in the development of Colorado agriculture. In 2011, Colorado growers received \$57 million for their sugar beet crop. Greenhouse and nursery crops are typically raised for residential, recreational, and commercial landscaping, for gardening, or for indoor ornamental use. In 2011, Colorado greenhouse and nursery operations received \$254 million for production and sale of a variety of horticultural, landscaping, and ornamental plants.

Livestock: Livestock production has historically been a major economic activity in Colorado, due to extensive rangelands across the high plains, the inter-mountain valleys, and the western slope. The livestock most commonly produced in Colorado is cattle, for both beef and dairy. In 2011, Colorado beef cattle operations received almost \$3.1 billion for marketing

of beef cattle, and dairies received \$594 million for milk production. Colorado is the leading U.S. state in production of sheep and lamb. In 2010 (the last year for which separate figures are available) Colorado sheep and lamb operations received \$111 million for sheep and lamb marketings and \$3.7 million for wool production. Other livestock include poultry production, with Colorado producers receiving \$94 million for sale of eggs in 2011. The equine industry still serves some roles in production agriculture, but raising horses for recreation is economically more important. In 2011, Colorado farms and ranches received about \$38 million for sales of horses. In Colorado, as a landlocked state, commercial aquaculture is not a major activity, but sold \$5.7 million in 2011: Of that trout was worth \$1.8 million. Honeybees may be insects, but they both produce honey and provide essential pollination services for orchard crops. Production by Colorado honeybees was worth \$2.7 million in 2011.

Services Provided: Farms and ranches also realize revenues from services provided. In 2011, Colorado farms and ranches received \$106 million for machine hire and custom work, largely provided to other farms and ranches. In 2007, Colorado farms and ranches received \$33 million for providing agtourism and recreational services.

Revenues from Risk Management Sources: Farms and ranches benefit from a range of risk management tools and strategies. Some risk management is provided by the federal government as part of U.S. public policy. These include commodity subsidies, conservation payments, and disaster payments, as well as premium subsidies to help farms and ranches purchase crop and livestock insurance coverage. Colorado farms and ranches received \$236 million from USDA commodity and conservation programs in 2011. On policies held by Colorado farms and ranches, crop and livestock insurance indemnities were \$143 million in 2011. (At the same time, \$129 million of the premium for these policies was subsidized by the federal government in 2011.)

Workforce: Assessing the Colorado workforce engaged in production agriculture is challenging. There are roughly three categories of those working on farms and ranches: owner-operators; employees (full time and part time); and contractors (including both skilled contractors and contracted labor). According to the 2007 Census of Agriculture, on Colorado's 37,054 farms and ranches, there were 59,479 primary operators. Of these, 23,705 describe

farming as their primary occupation, while the remaining 35,774 have another primary occupation. According to the Census of Agriculture, 7,393 of the 37,054 farms and ranches in Colorado hired at least one employee, including 15,454 as full time and 23,429 as part time employees. Machine hire and custom work, repair and maintenance, and veterinary services all represent services provided under contract. Those workers would be counted in their primary occupation elsewhere. Finally, no data was found regarding the numbers working as contract labor on Colorado farms and ranches.

Other sources estimate that there were 45,035 jobs in production agriculture in Colorado in 2012. Annual job growth in the farm and ranch sector was fairly stagnant, at just 0.7 percent. Total workforce earnings were over \$1.2 billion.

Off-farm Income: Finally, it is important to consider that, in addition to income from their farm and ranch operations, households of Colorado farm and ranch operators had an estimated off-farm income of \$3.5 billion in 2010, from working in other sectors of the economy. In addition, households of Colorado farm and ranch operators enjoyed home consumption of about \$10 million worth of their own crop and livestock products in 2011. Colorado farm and ranch operator households realize a \$360 million value of farm residential dwellings in 2011. Finally, for those who live and work in agriculture there is a less tangible value of the agrarian lifestyle that comes with operating a farm or ranch.

Further Down the Value Chain: Marketing, Processing, and Manufacturing

The vast majority of agricultural products are sold to intermediaries in the value chain who are able then to create additional value with those products, either by transporting and marketing them, by processing them, or by manufacturing products that use them as inputs. Out of a total of \$13.3 billion in sales by Colorado agricultural commodity marketing and food and beverage manufacturing, an estimated \$4.8 billion are sold in Colorado and an estimated \$8.5 billion are sold out of state; of those an estimated \$2.2 billion are sold as exports from the U.S.

Agricultural Commodity Marketing: Commodity merchants made an estimated \$160 million in sales in Colorado in 2011. Agricultural commodity exports

from the U.S. originating from the state of Colorado were estimated to be worth \$1.9 to \$2.2 billion in 2011.

Crop Processing: Grain and oilseeds mills sold \$163 million in 2011. Colorado ethanol plants sold an estimated \$118 million in 2011. Colorado sugar beet refineries sold \$62 million of sugar and co-products in 2011. Manufacturers of animal feeds and foods sold \$714 million in 2011. Of this, livestock feeds accounted for \$381 million and pet foods accounted for \$333 million. Fruit and vegetable processers in Colorado made sales of \$198 million in 2011.

Animal Processing: The sales of the animal slaughter and meat packing industry in Colorado were almost \$3 billion in 2011. Colorado firms produced only \$2 million of tanned hides and leather products in 2011. Dairy product manufacturing firms in Colorado accounted for \$1.9 billion in sales in 2011. Of this, cheese manufacturing accounted for \$1.2 billion.

Food and Beverage Manufacturing: Colorado food manufacturers of baked goods and confections sold \$1.1 billion in 2011. Colorado food manufactures across the range of other product categories not already considered sold \$786 million in 2011. Colorado beverage manufacturers sold \$5.3 billion in 2011. Of that, beer, at \$3.7 billion, was the largest beverage manufacturing sector.

Workforce: Over 27,000 were employed in agricultural commodity marketing and food and beverage manufacturing in Colorado in 2012. Employment was robust, with job growth in these sectors of 4.4 percent, and total earnings of roughly \$1.5 billion.

Yet Further Down the Value Chain: Wholesaling

Wholesalers are integral to the marketing and logistical functions of the value chain. Wholesaling involves the marketing arrangements as well as the storage, transportation, and distribution of agricultural and manufactured food products from suppliers or manufacturers to the retail outlets where they are offered for final retail. Food and beverage merchant wholesalers had estimated sales of \$2.5 billion in 2011 (although this likely underrepresents the total wholesale activity within the agricultural value chain).

Workforce: Over 19,000 were employed in the commodity marketing and wholesale sectors in Colorado in 2012. Job growth in these sectors was a healthy 4.7 percent in 2012. And total earnings were \$1.1 billion.

The Retail End of the Value Chain

Ultimately a value chain derives all of its value from the population of final consumers, those who place value upon the array of products and services offered. Nationwide, the six largest food retailers in the U.S.—*Walmart*, *Kroger* (*King Sooper* and *City Market* stores), *SuperValu* (*Albertsons* stores), *Target*, and *Whole Foods*—accounted for \$390 billion in food sales, or 73 percent of the total \$532 billion spent by U.S. households on food in 2011. We can expect that share of retail by these big six holds for the state of Colorado as well. Given that these retailers source their food products from all over the country and even the world, it is only reasonable that in most product categories, the vast majority of goods being sold in Colorado originate outside of Colorado.

Food and Beverage Retail: Extrapolating USDA national *per capita* food and beverage expenditure estimates to the Colorado population we calculate that Colorado consumers spent \$26.2 billion on food and beverage in 2011. Away-from-home expenditures on food and beverage were 53 percent of the total, meaning that Colorado consumers now spend more on food and beverage consumed away from home than on food and beverages consumed at home. Based on other data sources, supermarkets and other types of food and beverage retail establishments sold an estimated \$13.6 billion in 2011. Food service and drinking establishments in Colorado were estimated to have made \$10.6 billion in sales in 2011. Of that, full service restaurants accounted for just over half, at \$5.8 billion.

Green Industry Retail: Retail sales of nursery and greenhouse products and the revenues of landscaping services combined were \$1.3 billion in 2011.

Local Foods: Direct sales of locally grown farm products in Colorado were estimated to be \$22 million in 2007 (the latest year for which data is available). Intermediated direct sales—those made through established retail and food service channels—are estimated to have been three times

this amount, or about \$66 million, but cannot be measured directly. Both of these are expected to have grown significantly since 2007. Together, direct and intermediated retail sales of local foods are in the range of 5 percent of overall food and beverage retail.

Workforce: Over 307,000 Coloradoans are employed in the food and beverage retail, green industry retail, and food service retail sectors in Colorado. Job growth in these sectors between 2011 and 2012 was a modest 1.1 percent. Total earnings in these sectors were just over \$7 billion.

Value of Colorado Agriculture Not Realized in the Marketplace

Consumers also value some of the less tangible aspects of agriculture as well: things that cannot be simply bought and sold. These include such provisions of agriculture as open space, wildlife habitat, water quality, recreational opportunities, and the lifestyle and qualities of rural communities. There are several ways to measure, often with surprising accuracy, the value that people place on these less tangible benefits that agriculture provides. Methods include observing the purchase price of agricultural lands or of “development easements” on agricultural lands by public authorities or private foundations made in order to preserve them as open spaces, whether for watershed quality or for wildlife habitat. Methods also include observing payments made for things like travel and recreation (such as hunting or fishing trips), or the purchase price of nearby real estate, where the value of the experience being bought is at least partially dependent upon the value of agricultural land or activities.

It is also possible to observe the value that people derive from agriculture simply by asking them about it by survey. For example, one study by Colorado State University found residents of Chaffee County, Colorado, place a value of at least \$3 million per year on the preservation of the county’s working farm and ranch landscapes and water quality. Another survey by CSU found 86 percent of Colorado residents view the presence of farms, ranches, and agriculture as important to Colorado and over 97 percent felt that it is important to maintain agricultural land and water in agriculture.

Technological Innovation along the Value Chain of Colorado Agriculture

Advances in everything from data systems to genetics are enabling agricultural producers and food businesses to provide better products, at lower cost, all with a smaller environmental footprint, while at the same time becoming more profitable enterprises. Between 1970 and 2010, Colorado inventors received 2,643 patents in the technical areas of (crop and livestock) agriculture, animal health, and food, as well as associated mechanical, chemical, and life sciences. The annual rate of such patenting expanded fivefold between 1990 and 2010. Ten percent of the total patents issued over 40 years are owned by public sector institutions, 56 percent by companies in the private sector, and 33 percent by individual inventors. The top patenting organizations in Colorado's agriculture and food value chain are lead off by (1) Heska, (2) Colorado State University, (3) Martek Biosciences, (4) Dharmacon, (5) University of Colorado, (6) National Renewable Energy Laboratory, (7) Cargill, (8) Leprino, (9) JBS, and (10) Gates Corporation.

Conclusions: Supporting New Conversations about Colorado Agriculture

Together, all of Colorado agriculture shares a common fate—together with the wildlife that depend on Colorado's land and water, our livestock that similarly depend on forage and water, with the population who eat Colorado meat, grains, produce, and other products, as well as with the communities, businesses, schools, and families who make up Colorado. Colorado agriculture is a vibrant sector that can be counted on to support long-term economic growth and to develop the fabric of local and state wide communities. Understanding the resources and the constraints, the challenges and the opportunities shared all across the value chain of Colorado agriculture can only help to promote conversations that can result in strategic investments and innovative solutions for Colorado agriculture, and for Colorado.



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

The Value Chain of Colorado Agriculture

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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>