

# EXCHANGE: THE FUTURE OF WORK & AGRICULTURE

Workshop Report  
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# INTRODUCTION

Over millennia, agriculture has been central to human civilization, and all along, work has been at the center of agriculture. Ten thousand years ago, people labored to plant crops and herd livestock for the first time, facilitating a shift from a nomadic hunter-gatherer lifestyle to settled communities. These earliest crops of wheat and lentils and first herds of sheep and goats set the stage for human history; without agriculture and the labor behind it, we would not have established civilizations or developed governments and cities because agriculture, for the first time, provided humans with enough time to do more than find, prepare, and eat food—and to do the same thing again tomorrow.

Throughout history, agriculture has continued to be at the heart of transformations—including urbanization, industrialization, and globalization. As technology has developed over the past century, both society and agriculture have been

revolutionized. The international markets that started when early traders brought seeds and species across oceans have led to a complex global food system that engages an estimated 1.1 billion workers around the world.<sup>1</sup> As agriculture became more efficient and the number of people required to grow food declined, people have moved away from farms and into cities. Economies and their labor markets shifted first from an agricultural to an industrial basis, and now increasingly toward knowledge and data. As we move through the 21st century, agriculture and agricultural work, which have long been a staple of human society, face an uncertain future. Huge changes loom on the horizon: technological advancement, corporate consolidation, and climate change are all are poised to transform agriculture as we know it. These changes raise an important question: what does the future of agriculture hold for the agricultural workforce?

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1 International Labour Organization. "Agriculture; plantations; other rural sectors." <https://www.ilo.org/global/industries-and-sectors/agriculture-plantations-other-rural-sectors/lang--en/index.htm>.



## BACKGROUND

Since the first crops were planted, advances in technology and farming techniques have transformed agriculture; fertilization, irrigation systems, and crop rotation were among the earliest examples. Eight thousand years ago, fertilization began when farmers spread manure over their crops of wheat and barley.<sup>2</sup> Five thousand years ago, early agricultural engineers developed the first irrigation systems to use water from the Nile to irrigate the crops of ancient Egypt. One thousand years ago, farmers began regularly rotating crops. Each of these developments increased yields and changed the work required to be a successful farmer. Over the past 150 years, a series of technological developments has sped the pace of change and rapidly expanded agricultural productivity. The internal combustion engine brought mechanical plows, combines, and harvesters. Chemical engineering contributed synthetic fertilizers and pesticides. Genetics facilitated new forms of selective breeding and introduced new species. These advances ensured that agricultural output has kept pace with population growth, even as the agricultural workforce has shrunk significantly. In fact, between 1948 and 2015, agricultural output nearly tripled, while total input use grew just seven percent.<sup>3</sup> Labor and land inputs declined by 75 percent and 24 percent, respectively, over this period.

While agricultural technologies have transformed the types and amount of food produced, they have also transformed the work of farming. As productivity increased, the number of people working in agriculture decreased. In 1910, over 11 million workers—31 percent of the U.S. labor force—worked in agriculture, but by 2015, that number had fallen to 1 million workers—less than 2 percent of the labor force.<sup>4</sup> In recent years, the decline has leveled off, and the U.S. Bureau of Labor Statistics predicts employment of both agricultural managers and agricultural laborers to remain stable through 2028, with the potential for jobs lost due to agricultural automation to be offset by increasing demand for food and the need for machinery operators.<sup>5</sup> For example, the number of agricultural equipment operators, a subgroup of agricultural laborers, is projected to increase 10 percent by 2028, more than any other type of agricultural worker and more than the average for all occupations.<sup>6</sup> Technological change in recent decades has not only changed the number of agricultural workers; it has also changed the nature of agricultural work. For those working in agriculture, mechanical and scientific knowledge have taken on increased importance as more machines and chemicals have entered the farm. As technology continues to develop, and increasingly complex and currently unimaginable tools are

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2 Hergert, Gary, and Jim Margheim. 2015. "A Historical Overview of Fertilizer Use." *Ag Professional*. March 23. <https://www.agprofessional.com/article/historical-overview-fertilizer-use>.

3 Wang, Sun Ling, Richard Nehring, and Roberto Mosheim. 2018. "Agricultural Productivity Growth in the United States: 1948-2015." Economic Research Service, U.S. Department of Agriculture. March. <https://www.ers.usda.gov/amber-waves/2018/march/agricultural-productivity-growth-in-the-united-states-1948-2015/>.

4 Leon, Carol Boyd. 2016. "The life of American workers in 1915." *Monthly Labor Review*, Bureau of Labor Statistics. February. <https://www.bls.gov/opub/mlr/2016/article/the-life-of-american-workers-in-1915.htm>.

5 U.S. Bureau of Labor Statistics. "Farmers, Ranchers, and Other Agricultural Managers." *Occupational Outlook Handbook*. Last modified September 4, 2019. <https://www.bls.gov/ooh/management/farmers-ranchers-and-other-agricultural-managers.htm#tab-6>.

U.S. Bureau of Labor Statistics. "Agricultural Workers." *Occupational Outlook Handbook*. Last modified September 4, 2019. <https://www.bls.gov/ooh/farming-fishing-and-forestry/agricultural-workers.htm#tab-6>.

6 Ibid.

applied, it is likely that needed skills will continue to evolve.

Science and technology are not the only forces that have transformed agricultural work. As output has increased and employment has decreased, the organization of agriculture in the U.S. has also shifted with the consolidation of farms across the country and an increasingly international market for foods. A relatively small number of large, commercial farms oriented toward global demand have taken the place of small and mid-sized locally owned farms catering to local needs. In 2015, about 65 percent of total U.S. agricultural output came from farms with over \$350,000 in annual income.<sup>7</sup> Further illustrating the success of commercial farming, today, the majority of large farms are profitable year-to-year, whereas most of the decreasing number of small farms operate at a loss.<sup>8</sup>

The consolidation of commercial farms across the U.S. has intensified the polarization of agricultural work between farm managers and agricultural laborers. Although both are integral to the production of food, the experience of work in these two occupations is very different. Managers oversee farm operations, from determining which crops to plant or livestock to raise, to supervising

crop production and ranging, to purchasing supplies and maintaining equipment and facilities. Farm managers earn a median income of \$67,950 per year.<sup>9</sup> In contrast, agricultural laborers are workers who are hired specifically to maintain crops and tend livestock, mostly working outdoors performing physical labor and operating machinery. These workers earn a median income of \$24,620 per year, in jobs that are often temporary or seasonal.<sup>10</sup> The U.S. Department of Agriculture estimates three quarters of farm workers are born outside the U.S., and nearly half are undocumented.<sup>11</sup> With low pay, unstable work, and a lack of work authorization, these workers are among the most vulnerable in the U.S.

As agriculture has come to be dominated by large commercial farms, the makeup of the agricultural workforce has shifted; the portion of hired farm workers has increased while the proportion of farm managers has decreased.<sup>12</sup> The portion of agricultural workers in a vulnerable position, then, has increased, even as overall agricultural employment has declined. The combination of political tensions over immigration policy and corporate concentration casts further uncertainty on the future of agricultural labor.

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7 MacDonal, James, and Robert Hoppe. 2017. "Large Family Farms Continue to Dominate U.S. Agricultural Production." Economic Research Service, U.S. Department of Agriculture. March. <https://www.ers.usda.gov/amber-waves/2017/march/large-family-farms-continue-to-dominate-us-agricultural-production/>.

8 Prager, Daniel, Sarah Tulman, and Ron Durst. 2018. "Economic Returns to Farming for U.S. Farm Households." Economic Research Report Number 254, U.S. Department of Agriculture. August. <https://www.ers.usda.gov/webdocs/publications/89702/err-254.pdf?v=0>.

9 U.S. Bureau of Labor Statistics. "Farmers, Ranchers, and Other Agricultural Managers." Occupational Outlook Handbook. Last modified September 4, 2019. <https://www.bls.gov/ooh/management/farmers-ranchers-and-other-agricultural-managers.htm>.

10 U.S. Bureau of Labor Statistics. 2019. "Agricultural Workers." September 4. Occupational Outlook Handbook. <https://www.bls.gov/ooh/farming-fishing-and-forestry/agricultural-workers.htm>.

11 JBS International. 2018. "Findings from the National Agricultural Workers Survey (NAWS) 2015-2016: A Demographic and Employment Profile of United States Farmworkers." Prepared for the U.S. Department of Labor. January. [https://www.doleta.gov/naws/research/docs/NAWS\\_Research\\_Report\\_13.pdf](https://www.doleta.gov/naws/research/docs/NAWS_Research_Report_13.pdf).

12 Economic Research Service. "Farm Labor." U.S. Department of Agriculture. Accessed October 24, 2019. <https://www.ers.usda.gov/topics/farm-economy/farm-labor/#employment>.

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Perhaps the greatest source of uncertainty for the future of agriculture is climate change. Over the next hundred years, temperatures are predicted to rise between 2.5 and 10 degrees Fahrenheit, leading to reduced yield from many crops and breeds, increased soil erosion, and more common extreme weather events.<sup>13</sup> The impact on agricultural systems is uncertain but likely to be

significant, straining food systems as they struggle to meet the needs of a growing global population.

In order to prepare for a future shaped by these uncertainties, we need a clear understanding of trends, likely challenges, and proactive steps that can be taken to ensure an equitable and sustainable future.

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13 NASA's Jet Propulsion Laboratory. "The Effects of Climate Change." California Institute of Technology. Accessed November 1, 2019. <https://climate.nasa.gov/effects/>.



# CONVENING

With so much uncertainty, the future of work in agriculture is likely to look unlike anything we have seen before. The Aspen Institute Future of Work Initiative, with support from [X, the Moonshot Factory](#) (formerly Google X), brought together a range of experts for a design workshop to discuss current trends and challenges facing agriculture and agricultural work, new technologies and their potential impact on the industry and work, and ideas for potential intervention. Together, this diverse group, which included perspectives from the private sector, academia, nonprofits, and government, addressed the transformations currently underway, and explored policies and interventions that could pave the way for a future in which everyone is fed and all workers can thrive.

The first step in envisioning such a future is identifying how agriculture is changing, and how those changes impact agricultural work. Given participants' areas of expertise, the conversation focused on the ways technology is impacting agriculture. Some of these changes are highly visible, like robots planting, spraying fields, or harvesting crops, while others happen behind the scenes, such as computers using massive amounts of data to analyze crop performance. The conversation focused on both robotics and precision agriculture, and highlighted ways that these technologies are revolutionizing farming practices.

## Agricultural Robotics

The development of agricultural robotics began in the 20th century, with the goal of reducing the manual labor costs needed to produce food. Although few imagined at that time high-tech robots scampering through fields, the marriage of agriculture and robotics has a long history. In fact, some of the earliest autonomous vehicles were cable-guided agricultural tractors in the 1950s.<sup>14</sup> The field has expanded since then, especially in the past decade. Currently, the agricultural robots market is expected to reach \$11.58 billion by 2025.<sup>15</sup>

The work of a farm laborer is not easily automated. In contrast to an assembly line where industrial robots often perform repetitive tasks in a highly predictable environment, work in agriculture is more varied. Crops grow unpredictably on uneven soil and are subject to outside variables such as daylight, weather, weeds, and pests. For example, a peach does not grow predictably on a certain branch of a tree. Its level of ripeness requires experience to discern. And picking it without bruising or damaging it is a delicate task. The combination of expertise, flexibility, and precision needed to pick a single fruit is difficult to automate. However, such complex robots do exist, and are improving every day, even learning from their own mistakes as machine learning techniques are encoded into recent models.

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14 Yaghoubi, Sajjad, Negar Ali Akbarzadeh, Shadi Sadeghi Bazargani, Sama Sadeghi Bazargani, Marjan Bamizan, and Maryam Irani Asl. 2013. "Autonomous Robots for Agricultural Tasks and Farm Assignment and Future Trends in Agro Robots." *International Journal of Mechanical & Mechatronics Engineering* 13, No. 3 (June): 1-6. [http://www.ijens.org/Vol\\_13\\_I\\_03/134301-1303-8989-IJMME-IJENS.pdf](http://www.ijens.org/Vol_13_I_03/134301-1303-8989-IJMME-IJENS.pdf).

15 Verified Market Research. 2018. "Global Agriculture Robots Market Size By Type (Driverless Tractors, Automated Harvesting Machine, Others), By Application (Field Farming, Dairy Management, Indoor Farming, Others) By Geography Scope and Forecast." September. <https://www.verifiedmarketresearch.com/product/global-agriculture-robots-market-size-and-forecast-to-2025/>.

One example of an advanced agricultural robot is a strawberry picker developed by Harvest CROO Robotics. The most recent version of this robot can pick an entire strawberry plant in 8 seconds and move to the next plant in 1.5 seconds. It can pick 8 acres in a day, doing the labor of 30 human pickers.<sup>16</sup> These robots are still far from perfect and often miss much of the fruit on each plant, but the potential labor cost savings still excite many in the industry.<sup>17</sup> Automated pickers have also been developed for grapes and citrus, with more specialized machines under development.

Harvesting is not the only task impacted by expanding robotics. EcoRobotix, a Swiss company, has developed a solar-powered and GPS-navigated robotic weeder. This machine roams fields using cameras to identify weeds. A robotic arm then sprays each weed with a microdose of herbicide. The weeder, which is controlled by a farmer's smartphone, reduces the amount of herbicide used by 90 percent, saving money and lessening environmental impacts. Although the technology can be expensive, it can significantly reduce spending on herbicides.<sup>18</sup>

Dairy farms are beginning to transform as they increasingly adopt robotic milkers, or "milk bots." An estimated 4.5 percent of U.S. dairy farms currently utilize these robotic milkers, which automate the milking process.<sup>19</sup> These systems can collect data on cows' health and milk production, providing information that manual milking never could. Like other robots, milk bots require significant upfront

investment, but can reduce labor costs and free farm workers to perform other duties. Robots have not limited their animal husbandry to cows; other livestock robots shear sheep and collect eggs.

When different robotic technologies come together, they can tend entire crops from planting to harvesting. In fact, with indoor farming, where variables such as temperature and water can be controlled, an entirely autonomous farm can operate—a prospect being pursued by the start-up Iron Ox.<sup>20</sup> On such a farm, future farmers could tend a range of crops without ever leaving an office, or even from the other side of the world.

## Precision Agriculture and Data Science

Not all technological advancements in agriculture can be seen roaming fields or milking cows. Some of the most revolutionary developments happen behind the scenes, as computers crunch numbers and tell farmers when to plant, treat, and harvest—sometimes for each individual plant. Precision agriculture refers to a suite of technologies that provide farm operators with data, including detailed spatial information, that can be used to optimize field, flock, and herd management practices. The data collected can inform management decisions, including where, when, and what to plant and harvest. The goals of these technologies are to

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16 To learn more about Harvest CROO Robotics, visit <https://harvestcroo.com/about/>.

17 Paquette, Danielle. 2019. "Farmworker vs Robot." *Washington Post*. February 17. <https://www.washingtonpost.com/news/national/wp/2019/02/17/feature/inside-the-race-to-replace-farmworkers-with-robots/>.

18 To learn more about ecoRobotix, visit <https://www.ecorobotix.com/en/autonomous-robot-weeder/>.

19 Reed, Elodie. 2018. "The Cow-Milking Robots Keeping Small Farms in Business." *The Atlantic*. October 11. <https://www.theatlantic.com/business/archive/2018/10/young-dairy-farmers/567937/>.

20 Winick, Erin. 2018. "New autonomous farm wants to produce food without human workers." *MIT Technology Review*. October 3. <https://www.technologyreview.com/s/612230/new-autonomous-farm-wants-to-produce-food-without-human-workers/>.

improve accuracy and efficiency in farming in order to reduce input costs and increase yields.

For example, soil mapping technology allows farmers to sample different parts of a field for soil structure and chemical properties. This information can then be used to determine what should be planted where, how much water, fertilizer, or other chemicals should be applied, and when to harvest. Data on crops as they grow and are harvested can then be analyzed in order to make better predictions for the next growing season. Geo-referenced data allows for high degrees of customization; plants in one row of a field may require slightly different treatment than plants in the next row over.

GPS technology, in conjunction with advanced data analytics, allows farmers to carry out these highly customized treatments. Tractors and other machinery can identify specific locations within a field, and employ what is called variable-rate technology (VRT). VRT helps farmers optimize inputs like fertilizer and pesticide by applying them at varying rates within fields or rows, saving money on chemicals while reducing environmental impact. Half a century ago, a farmer would drive a tractor through a field and distribute seeds, water, and chemicals evenly. Today, GPS-aided tractors can automatically disperse tailored levels of inputs to each square foot of field, aware of minor contours and variations even if invisible to the farmer, and can operate even in low-visibility conditions like rain, fog, dust, and darkness.

Despite the potential to provide cost savings to farms of all sizes, the adoption of VRT technology is currently concentrated among large commercial farms, and is still quite limited, due to high startup costs, and the considerable amount of training and expertise required for successful deployment.

Though more attainable for those with larger operations, these technologies have the potential to enable smaller scale agriculture to be more financially viable, helping them more efficiently use less land to produce more and better quality crops. Early evaluations hint at this potential; a study of 3,380 American farmers found that those implementing precision technology reported an average cost reduction of 15 percent and an increase in average yields of 13 percent—meaning they are able to produce more with less.<sup>21</sup>

Precision agriculture techniques may be particularly valuable in understanding the impacts of climate change. Collecting detailed data in real time can provide a clearer understanding of the impacts of single weather events as well as long-term trends, equipping farmers to plan ahead and make changes to crops and husbandry plans that allow for continued or increased productivity even in the face of challenging external conditions.

Issues related to technology, consolidation, and climate change need to be considered together. Technology allows us to better understand, prepare for, and prevent climate change. But in order for that promise to be fulfilled, it needs to be adopted across the country, on farms large and small. Consolidation means that the adoption of technology is likely to be unequal across the industry, and is currently positioned to benefit large corporate farms more than small and locally owned farms—exacerbating inequalities while also limiting the potential of technology to serve the social good through informing climate change strategy. Thinking proactively about equitable technological adoption can counterbalance the economic forces contributing to concentration, and equip farmers and society to better address the threats of climate change.

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21 Stanford Value Chain Innovation Initiative. 2017. "Technology in Agribusiness: Opportunities to Drive Value." Stanford Graduate School of Business. August. <https://www.gsb.stanford.edu/sites/gsb/files/publication-pdf/white-paper-vci-technology-agribusiness-opportunities-drive-value.pdf>.

## Solutions and Recommendations

Participants in the workshop identified four innovative policy areas that hold promise to facilitate equitable adoption of agricultural technology, counteracting the impacts of consolidation and maximizing the potential for technology to address climate-related agricultural challenges.

Of course, traditional agricultural policy—including subsidies, crop insurance policies, and trade policies—needs to consider the current trends transforming agriculture. These policy areas are and have long been at the heart of agricultural policy debates. While the discussion did not take on the charge of overhauling our nation’s food, agriculture, and trade policy, there was broad agreement that it is important that policy reforms reflect the rapid changes in technology, the structure of agriculture, and our climate. The scope of current transformations broadens the scope of what policies are relevant to agriculture, and it is this new frontier of ag-tech policy on which this convening focused.

These policy recommendations have new relevance to the industry in an age of rapid technological development. As we look into the fields and into the future, these areas are important for anyone invested in agriculture, including consumers.

**1. Technology Infrastructure:** Under the current structure of increasing consolidation, large firms are likely to benefit more from new technology due to increased access, and exacerbate the challenges of a fragmented agricultural workforce. There are several barriers to an equitable dissemination of technology across the agricultural industry, with the largest hurdles for small farmers. In the absence of coordinated federal policies and regulatory accountability, a lack of broadband deployment in rural areas across the country has left many farms and communities without the opportunity to remain competitive in the industry.<sup>22</sup> The U.S. Department of Agriculture recently reported that 25 percent of U.S. farms do not have access to the Internet.<sup>23</sup> Thus, they lack the connectivity needed to learn about recent developments, much less integrate high-tech and Internet-dependent machinery into their farming practices. In order to enable all farms and agricultural workers to participate in the increasingly technology-driven industry, it is important to develop a comprehensive strategy for providing underserved and rural communities with high-speed broadband access. Toward this end, the Federal Communications Commission (FCC) recently announced a new advisory committee, the Task Force for Reviewing Connectivity and Technology Needs of Precision Agriculture in the United States.<sup>24</sup> The Task Force will identify the connectivity needs on agricultural land and develop effective

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22 Ali, Christopher. 2019. “We Need a National Rural Broadband Plan.” *New York Times*. February 6. <https://www.nytimes.com/2019/02/06/opinion/rural-broadband-fcc.html>.

23 National Agricultural Statistics Service. 2019. “Farm Computer Usage and Ownership.” U.S. Department of Agriculture. August. <https://downloads.usda.library.cornell.edu/usda-esmis/files/h128nd689/8910k592p/qz20t442b/fmpc0819.pdf>.

24 Federal Communications Commission. 2019. “FCC Announces the Establishment of the Task Force for Reviewing Connectivity and Technology Needs of Precision Agriculture in the United States and Seeks Nominations for Membership.” June 17. <https://docs.fcc.gov/public/attachments/DA-19-568A1.pdf>.

policy solutions to promote the deployment of broadband precision agriculture technologies, with the goal of achieving reliable Internet capabilities on 95 percent of U.S. agricultural land by 2025. As the FCC prepares to invest in improving connectivity across the country, the agency is working to improve the accuracy of its broadband mapping data.<sup>25</sup>

**2. Data Privacy:** The techniques and tools of precision agriculture can allow farms to be more productive and better tailored to market demands while minimizing environmental impact. They can also produce huge amounts of data. The data produced by these new tools and techniques raise concerns about data privacy and ownership. In fact, on a Stanford survey of farmers, 77.5 percent of respondents were concerned about data privacy issues related to using new technology.<sup>26</sup> In many cases, more data allows higher degrees of precision—the more data at a farm’s disposal, the more effective its precision agriculture techniques can be. If companies that develop and manage agricultural technology make data from small farms accessible to large, corporate farms, it may be against the small farms’ interest to use new techniques, since their data may increase the already sizeable competitive advantage of the large farms. Allowing farmers to retain ownership of data gathered from their crops can increase take-up of these practices, and

ensure small farmers have a chance to reap their benefits. At the same time, data sharing initiatives between small farms may allow them to maximize the benefits and compete against the larger players. Rather than analyzing the inputs given to just one field of soybeans, they could analyze those given across several fields on several farms, similar to the scope of a large commercial farm, and learn more about what optimizes the production process than they could on their own.

**3. Education and Training:** As the tools of agriculture evolve, the skills needed to be an effective farm manager or agricultural worker have similarly shifted. Neither the role of farm manager nor agricultural worker has typically required postsecondary education, but as farming has become more complex and digital technology has become more commonplace, farm managers are increasingly pursuing higher education, often through land grant universities.<sup>27</sup> Incorporating advancing technology into farming practices requires new technical and digital skills that are likely difficult to pick up through community-based learning and experience on traditionally managed farms, where agricultural workers have long learned their trade. Both farm managers and agricultural workers need access to training to learn about new technological tools and how to use them, so that they can invest with greater confidence and

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25 Reid, Jon. 2019. “FCC to Weigh Broadband Mapping Order in August.” *Bloomberg Law*. June 12. <https://news.bloomberglaw.com/tech-and-telecom-law/fcc-to-vote-in-august-to-improve-broadband-mapping>.

26 Stanford Value Chain Innovation Initiative. 2017. “Technology in Agribusiness: Opportunities to Drive Value.” Stanford Graduate School of Business. August. <https://www.gsb.stanford.edu/sites/gsb/files/publication-pdf/white-paper-vci-technology-agribusiness-opportunities-drive-value.pdf>.

27 U.S. Bureau of Labor Statistics. “Farmers, Ranchers, and Other Agricultural Managers.” Occupational Outlook Handbook. Last modified September 4, 2019. <https://www.bls.gov/ooh/management/farmers-ranchers-and-other-agricultural-managers.htm>.

U.S. Bureau of Labor Statistics. “Agricultural Workers.” Occupational Outlook Handbook. Last modified September 4, 2019. <https://www.bls.gov/ooh/farming-fishing-and-forestry/agricultural-workers.htm#tab-6>.

take full advantage of new tools once adopted. Community colleges, public universities, and agricultural extension programs can all play a critical role in providing this type of training. In addition, new training programs can offer lifelong learning to those already working in agriculture, bringing new tools and knowledge to an experienced workforce. Agricultural extension offices, which operate out of public land-grant universities and have long offered continuing education to farmers and other agricultural workers, have been leaders developing these sorts of opportunities. For example, Michigan State University has offered a three-day workshop to introduce farmers to drones as an agricultural tool.<sup>28</sup> University of California Cooperative Extension has hired trainers to work with farmers and ranchers to adopt climate-smart agricultural technologies across the state.<sup>29</sup> For new farmers, Tennessee State University created a seven-month certificate-based academy that covers GIS mapping and modern machinery operation, among other topics.<sup>30</sup> By offering continuing education on changing practices to experienced agricultural workers, and inspiring young students to go into the increasingly technological field of farming, educational institutions have a key role to play in shaping the future of agriculture and agricultural work.

**4. Prioritizing Equity:** The needs of the agricultural workforce, both farm managers and hired workers, must be addressed in order to ensure our food system remains stable and meets the needs of our population. The consolidation of farms has contributed to a polarization of agricultural employment between low-wage agricultural workers and higher-paid farm managers. An increasing portion of the agricultural workforce is contending with low wages and jobs that are often temporary or seasonal and typically lack benefits. In order to ensure that today's farm managers, most of whom are small family farmers, are equipped to succeed, policymakers should consider additional support for small farmers to aid in the takeup of new technologies. To ensure that all hired agricultural workers have quality jobs, policymakers should consider extending to them the workplace benefits and protections afforded to other workers under the Fair Labor Standards Act and the National Labor Relations Act—two critical pieces of legislation that left out agricultural workers. Given the lack of federal protections, several states have passed legislation protecting farmworkers' rights to collectively bargain. This year, New York passed the Farm Laborers Fair Practices Act, which ensures the right to organize along with overtime pay, workers' compensation, and Unemployment Insurance.<sup>31</sup> In addition,

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28 Goodwin, Robert. 2017. "Drones in Agriculture and Hands-On Drone Training." Michigan State University Extension. February. [https://www.canr.msu.edu/news/drones\\_in\\_agriculture\\_and\\_hands\\_on\\_drone\\_training](https://www.canr.msu.edu/news/drones_in_agriculture_and_hands_on_drone_training).

29 Warnert, Jeannette. 2019. "UC Cooperative Extension Deploys a Team of 10 to Help Farmers Practice Climate-Smart Agriculture." University of California Agriculture and Natural Resources. December. <https://ucanr.edu/News/?routeName=newsstory&postnum=38822>.

30 Tennessee State University. "Tennessee New Farmer Academy." Last modified November 12, 2019. <http://www.tnstate.edu/extension/NFA.aspx>.

31 State of New York. "S 6578: Farmworker Fair Labor Practices Act." Passed June 18, 2019. <https://www.nysenate.gov/legislation/bills/2019/s6578>.

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updating social safety net programs to better serve workers in temporary and seasonal jobs, like introducing portable benefits, promises to provide higher levels of financial security for these workers, along with millions of others who increasingly face contingent and “gig” work. In addition, immigration policies that facilitate safety and paths to citizenship for undocumented workers are essential.

As uncertain as the future is, we have an opportunity to shape the future we want—but it will depend

on setting goals, understanding challenges and barriers, and planning ahead. Workshop participants laid important groundwork for broadening the conversation about agricultural policy to include important topics that are at the heart of current trends. By ensuring an equitable distribution of the benefits of new agricultural technology, equipping agricultural workers to thrive in an increasingly digital and robotic world, and promoting quality jobs across the industry, policymakers have the potential to shape a promising future for agriculture in America.



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### About the Aspen Institute Future of Work Initiative

The Aspen Institute Future of Work Initiative is a nonpartisan effort to identify concrete ways to address the challenges American workers and businesses face due to the changing nature of work in the 21<sup>st</sup> century. Several trends are impacting workers and businesses today, and could bring dramatic transformations in the years ahead: the weakening social contract between workers and employers, the increased importance of access to education and skills resulting from new technologies and increased automation, and the pressure to produce short-term profits rather than long-term value. Rather than waiting to react to future disruptions, it is critical to develop solutions that address the changes transforming the U.S. economy. The Initiative focuses on policy ideas at the federal, state, and local level to:

- Improve economic security for both traditional and independent workers
- Expand investment in and access to effective education and training programs
- Reduce pressure on public companies to prioritize short-term profits and encourage investment in long-term value creation

Established in 2015, the Initiative is driven by the leadership of Honorary Co-Chairs Senator Mark R. Warner and Purdue University President and former Governor of Indiana Mitch Daniels, and Co-Chairs John Bridgeland and Bruce Reed. Executive Director Alastair Fitzpayne leads an Aspen Institute staff, based in Washington, DC.