# California Case Study – Full Belly Farm

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## Background

California is one of the most important agricultural producing locations in the world. The state's agricultural industry has a critical role in food production to meet domestic and global demand. At the same time, climate change will force vast elements of the industry to adapt to altered conditions in order to sustain production. The USDA Climate Hubs, in partnership with NRCS, have developed a suite of case studies to showcase how farmers and ranchers can use an adaptation planning framework to identify and explore practices that increase resilience to climate-related impacts. The framework consists of a five-step process which is laid out fully in the USDA Adaptation Resources for Agriculture Workbook.[1] The five-step process aims to (1) define specific operational goals of a producer, (2) assess how climate change may impact their ability to meet those goals, (3) evaluate opportunities for adapting to changing climate conditions, (4) identify adaptation practices, and (5) monitor and evaluate effectiveness of adaptation practices. Producers that use this process to evaluate and alter their production system may increase their capacity to adapt their operation to changing climate conditions, ameliorate climate-related impacts, and maintain – or even increase – productivity.

The USDA California Climate Hub has partnered with Full Belly Farm in Yolo County to illustrate how a grower can use and navigate the adaptation planning process to ultimately adapt to climate change. Full Belly Farm is a diverse 400-acre farm in the Capay Valley of Yolo County, northwest of Sacramento. The farm was founded in 1985 by four partners. For this case study we worked with two of the founding and current partners, Judith Redmond and Paul Muller. Full Belly Farm was chosen as a case study due to their long-standing efforts to promote sustainability, their creativity and experimentation with management practices, and their commitment to land and community stewardship.

[1] The Adaptation Resources for Agriculture Workbook is designed for the Midwest and Northeast Regions, however a workbook designed for California agriculture is forthcoming.

*Diana Rothery, courtesy of Full Belly Farm*

Full Belly Farm is certified organic by California Certified Organic Farmers and USDA National Organic Program and produces over 80 different crops including almonds, walnuts, tomatoes, cut flowers, grains, potatoes, and other specialty crops. In addition, the farm produces a variety of value-added products such as dried-flower wreaths, jams, preserves, and nut butter. The farm also has a herd of sheep, laying hens, and pigs. Full Belly's operational goals are to farm the land sustainably, promote biodiversity, have a low impact on water resources, provide stable work for employees, and foster an operation that will successfully continue into the future. For the purposes of this case study, we will focus on Full Belly's goals of ecological sustainability, economic profitability, and stable year-round work for employees.

## Site Description and Conditions

*Full Belly Farm's geographic location is provided for regional context related to on-farm conditions. This section includes information on commodities and products grown in Yolo County as well as general information on the region's climate, soil, and water in order to understand how management decisions relate to their regional and on-site conditions.*

### Geography

The Capay Valley region of Yolo County lies between the Inner Northern Coast Range and Sacramento. Capay Valley is part of the Sacramento Valley and is characterized by fertile agricultural soils, due in part to Cache Creek. A tributary to the Sacramento River, Cache Creek begins at Clear Lake and runs through Capay Valley.

Yolo County has about 500,000 acres in agricultural production, made up of over 1,000 farms with an average size of 450

*Image 1: Location of Full Belly Farm in Yolo County. Source: Google Maps, 2020.*

acres.[2] In 2019 the gross value of agricultural production in Yolo County was $765,231,000 and the top ten grossing commodities were almonds, wine grapes, tomatoes, rice, organic vegetables, walnuts, alfalfa hay, sunflower seed, pistachios, and nursery products.[3] Capay Valley is an important region for production of almonds, walnuts, and organic mixed vegetables.[4]

## Climate

*Information in this section is based on Cal Adapt, the Sacramento Valley Region Report for California's 4th Climate Change Assessment, and the U.S. Climate Resilience Toolkit. Please note historical temperature data on Cal Adapt is only available up to the year 2005.*

Like the vast majority of California's farms, ranches and dairies, Full Belly experiences a Mediterranean climate characterized by hot, dry summers and relatively cool, wet winters – which results in a mismatch between water availability in the winter and ideal growing conditions in the summer. The historical average (1950-2005) annual maximum temperature was 73.8°F, with annual rainfall of 19.7 inches. However projected future average annual maximum temperature is expected to rise 3.4°F to 77.2°F within the next 30 years (2021-2050).[5] Average future precipitation is likely to be at or above historical levels but with increased variability.[6] Larger and longer lasting storm events, like atmospheric rivers, may lead to more **intense floods** in some years. Additionally, with higher temperatures in concert with **more heat waves**, **lower soil moisture** and **plant stress** are likely to occur.

In the long-term, from 2050-2075, average maximum temperature is expected to rise further to 79.9°F. In addition to higher temperatures and flooding from large storms, climate change impacts for the Sacramento Valley Region include more **extreme heat waves** and more **intense droughts** with less predictability, and increased risk of **wildfire**.[7] The farmers at Full Belly are particularly concerned with extreme heat days, wildfire smoke, extended droughts, and **spring freezes** due to temperature shifts.

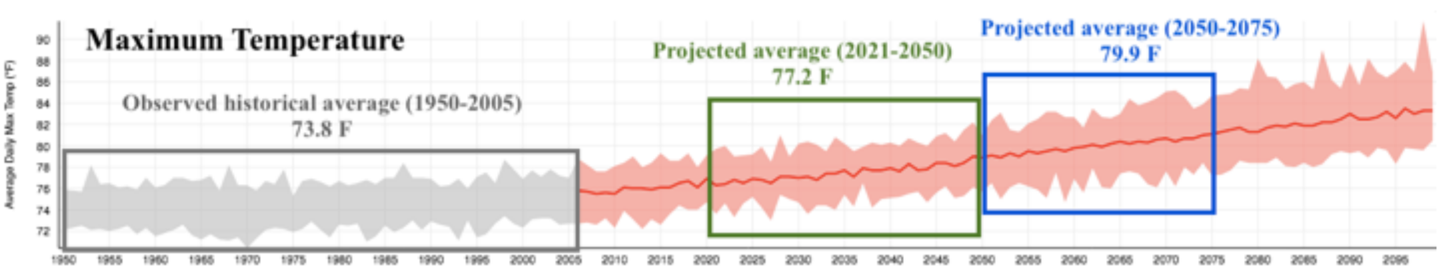


*Figure 1: Projections of annual average maximum temperatures for Capay Valley Region. The range of average maximum temperature projections is based on 32 climate models, with the red line representing the average annual maximum temperature. This is based on a high emissions scenario where global greenhouse gas emissions continue*

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[2] USDA National Agricultural Statistics Service. (2013). *Yolo County Profile. 2012 Census of Agriculture.* Retrieved from https://www.nass.usda.gov/Publications/AgCensus/2012/Online_Resources/County_Profiles/California/cp06113.pdf

[3] Yolo County 2019 Agricultural Crop Report. (2020). Retrieved from https://www.yolocounty.org/general-government/general-government-departments/agriculture-cooperative-extension/agriculture-and-weights-measures/crop-statistics

[4] Richter, K. R. (2009) *Sharpening the Focus of Yolo County Land Use Policy*. Retrieved from University of California Agricultural Issues Center https://aic.ucdavis.edu/publications/yoloLUPlo.pdf

[5] Cal Adapt. (2020). *Annual Averages*. Retrieved from https://cal-adapt.org/tools/annual-averages/

[6] Swain, D. L., Langenbrunner, B., Neelin, J. D., & Hall, A. (2018). Increasing precipitation volatility in twenty-first-century California. *Nature Climate Change, 8*(5), 427-433. doi:10.1038/s41558-018-0140-y

[7] Houlton, B. Z., Lund, J. R. (2018). *Sacramento Summary Report. California's Fourth Climate Change Assessment*. Retrieved from https://www.energy.ca.gov/sites/default/files/2019-11/Reg_Report-SUM-CCCA4-2018-002_SacramentoValley_ADA.pdf

*to rise through 2100 (RCP 8.5). Readers can explore more at U.S. Climate Resilience Toolkit Climate Explorer. Source: Cal Adapt, 2020, and U.S. Climate Resilience Toolkit Climate Explorer, 2020.*

Extreme heat is a chief concern at Full Belly. Judith Redmond shared that temperatures of 95°F and higher have severe consequences for worker health and safety and can affect crop pollination. Between 1950-2005 there was an average of 38 days a year over 95°F, which is projected to increase. In the short term (2021-2050), the projected yearly number of extreme heat days is 70 and in the long term (2050-2075) that number is projected to increase to 89 days a year. (Note: the default extreme heat threshold for the region is 103.9°F on Cal Adapt, but for the purposes of this case study, 95°F is used because Full Belly defined it as the threshold for impacts to their operation.) There is a sharp projected increase in the average number of 4-day heat waves (at or above 95°F) as well, going from 6 heat waves a year up to 13 in the short term (2021-2050) and 18 in the long term (2050-2075).[8] Heat waves have significant impacts on worker health and safety, crop health, soil moisture, and electrical reliability, which are all concerns for Full Belly. Further discussion of how challenges from climate change impact management decisions at Full Belly is below.

*Table 1: Historical averages and projected changes in maximum temperature, extreme heat days, and heat waves for Full Belly's region. Source: Cal Adapt, 2020.*

| Climate variable (annual average) | Historical (1950-2005) | Short term projections (2021-2050) | Long term projections (2050-2075) |
|---|---|---|---|
| **Maximum temperature (F)** | 73.8° | 77.2° | 79.9° |
| **Extreme heat (days over 95°F)** | 38 | 70 | 89 |
| **Heat waves (4 days above 95°F)** | 6 | 13 | 18 |

## Soils

Much of the low lying Sacramento Valley consists of mixed alluvium parent material. At Full Belly, soils are predominantly loam, silt loam, or sandy loam made up of Yolo, Tehama, and Brentwood series. Full Belly soils are well drained and classified as prime farmland if irrigated.[9]

## Water

Water is managed by the Yolo County Flood Control and Water Conservation District. During the growing season, water is released into Cache Creek from Clear Lake and Indian Valley Reservoir. Full Belly relies on Cache Creek and groundwater for irrigation, with 60% coming from Cache Creek. Full Belly is impacted by drought, particularly if the drought extends 2-3 years or longer and Cache Creek dries up. Redmond shares that although they feel lucky to farm in an area with a healthy aquifer, groundwater resources are still impacted by extended drought. In the last few years of the California drought from 2012 to 2016, groundwater levels sank in the region. Water was no longer available from Cache Creek, and Full Belly was asked to stop irrigating on certain parcels. During drought conditions, Redmond says they have to make decisions about what to grow and focus on crops with a high yield per drop of water.

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8 Cal Adapt. (2020). *Extreme Heat.* Retrieved from https://cal-adapt.org/tools/extreme-heat/

9 California Soil Resource Lab, UC Davis. (2020). *SoilWeb.* Retrieved from https://casoilresource.lawr.ucdavis.edu/gmap/

Full Belly is also impacted by floods – Redmond says they experience a significant flood every 8-9 years. The region received a record high amount of rainfall in early 2017 causing Indian Valley Reservoir to fill and Clear Lake to reach flood stage. Water was dumped into Cache Creek and Redmond recalls the flood washing out a bridge upriver from the farm and causing significant ecological damage on the property.

*Image 2: Aerial view of part of Full Belly Farm (outlined), which runs along Cache Creek in Capay Valley, CA. There are other non-contiguous rented parcels. Source: Google Earth, 2020.*

## Full Belly Farm adaptation exercise

*The following section provides an example of how to walk through the five-step adaptation planning process using Full Belly Farm's stated goals and objectives in concert with projected climate impacts and expected future conditions for their site*.

### (1) Define Management Goals and Objectives

Step (1) is defining the operational goals of Full Belly Farm, which will be used throughout the adaptation planning process. Full Belly Farm partners are long-time advocates of environmental stewardship and sustainable practices. They strive to support local food systems and sell most of their produce within a 120-mile radius of the farm. The farm sells wholesale to restaurants and stores, direct to consumers at farmers markets, and supports a robust Community Supported Agriculture (CSA) program each year. The partners at Full Belly Farm are passionate about engaging with the community and host outreach events including farm dinners, educational tours, school group visits, and an annual festival. The farm is committed to providing year-round stable employment for workers and sees itself as part of a larger fabric of sustainable food production and land stewardship. For the purposes of this case study, we are focusing on Full Belly's goals of **ecological sustainability**, **economic profitability**, and **stable employment for workers**.

*Table 2: Overview of Full Belly Farm's management goals and objectives.*

| Overarching management goals | Management objectives |
|---|---|
| Be ecologically sustainable and be a good steward of natural resources | • Maintain soil health<br>• Maintain or increase soil organic matter<br>• Increase water holding capacity<br>• Promote biodiversity |
| Be economically profitable | • Diversify crops and activities on the farm<br>• Minimize expenses |
| Provide stable employment for workers | • Ensure crew safety and comfort<br>• Provide work year round |

### (2) Assess climate change impacts and vulnerabilities

Step (2) focuses on assessing how climate change may impact Full Belly and identifying impacts that are of specific concern to the operation. For Full Belly, impacts such as extreme weather events and heat, flooding and erosion from heavy rain, extended drought, wildfire smoke, and spring freezes are top concerns. Many farmers in the area are concerned with heat stress and extended drought. At Full Belly, they have concerns about how extreme heat will impact the health and safety of their employees. Redmond shares, "In terms of worker health and safety, you have to have a lot more breaks when it's above 95 degrees and people are working. You have a harder time really keeping people safe." There are fewer working hours available on extremely hot days, and it presents a real cost to have shorter days.

Climate impacts may also be interrelated and overlapping. For example, warmer temperatures and extended drought may reduce soil moisture and make the soil more likely to erode in the event of heavy winter rains or flooding.

*Table 3: Overview of climate change impacts for the region and priority concerns for Full Belly Farm.*

| Climate Change Impacts and Vulnerabilities | Concerns for Full Belly |
|---|---|
| **Warmer temperatures:** Temperatures are expected to rise 5-6°F and the number of extreme heat days over 95°F will rise sharply | They describe the following concerns:<br>• Crop heat stress<br>• Worker health and safety is at risk during extreme heat days<br>• Failed crop pollination during extreme heat days |
| **Extended drought:** Increased climate variability and changes in precipitation patterns may mean longer periods of drought | • Water availability<br>• Decreased soil moisture |
| **Heavy rains:** Variability in precipitation patterns is expected, with an increase in large storms and periods of heavy rains | • Parts of the farm will flood, especially close to Cache Creek<br>• Soil erosion as a result of flooding |
| **Severe wildfires:** The number of severe wildfires is expected to increase in California | • Worker health and safety is at risk due to wildfire smoke<br>• Energy reliability |
| **Variability in freezes/frost:** A freeze may occur later than usual in spring | • Spring freeze can harm or stunt growth of developing fruit crops |
| **Lack of electrical reliability:** Power outages are common, particularly during periods of high winds, extreme heat, or wildfires | • Without power many key functions at Full Belly cannot operate including irrigation, produce coolers/freezers, and the office phone and computer systems. |

### (3) Evaluate management objectives given projected impacts and vulnerabilities

Step (3) is evaluating Full Belly's goals in light of climate change impacts. Climate change creates concerns for meeting all three of Full Belly's operational goals of ecological sustainability, economic profitability, and stable employment for workers. Redmond speaks about the increasing variability in climate conditions, "You have to stop planning for each year to be the same. You have to start planning for each year to be different, to almost expect that you're going to have to change from year to year."

Full Belly Farm sees soil health and diversification of crops as opportunities to mitigate the impacts of climate change and make their farm more resilient. With regard to soil health, **building soil organic matter** not only provides fertility for crops, but improves the water holding capacity and retention in the soil. **Covering bare ground** is important to retain soil moisture, reduce erosion, and maintain a more stable soil temperature for crops that reduces crop stress and helps crop productivity. For Full Belly, feeding a **diverse soil ecology** is a way to reduce risk and prepare for the lack of predictability. They take a holistic approach to managing the land that supports diversity within the ecosystem and focuses on soil ecology, not just soil chemistry.

There is a problem-solving mentality within a set of organic agriculture constraints at Full Belly. They attempt to balance short-term needs and long-term goals by choosing practices that will provide future benefits, even if extra labor is required. For instance, even though bare soil is very easy to plant into, they have a goal of reducing bare ground in order to support soil ecosystems that **use water more efficiently**. Full Belly aims to solve problems by taking a whole ecosystem approach to farming and reaping the benefits of natural processes. This way of thinking outside the box and being creative while remaining consistent with their values is one reason Full Belly has been successful. They begin by identifying management practices that have the potential to provide positive benefits into the future, such as no till or minimum till. Once they have identified practices, Paul Muller says they decide what they are willing to risk experimenting with that set of new practices.

Many impacts from climate change present extra expenses for the farm, which can add up to be costly. Redmond speaks about the economic impacts of crop loss due to extreme heat, spring freeze, or flooding, as well as costs of purchasing generators for power outages and losing equipment due to electrical brown-outs. Diversification of crops and activities is one way to offset costs of crop losses for Full Belly. Redmond shares, "Diversity is the key to our insurance and stability in the face of uncertainty."

## (4) Identify adaptation practices

Step (4) aims to identify specific adaptation practices that Full Belly can take (or is already taking) in order to meet their operational goals in the face of climate change. Full Belly fosters an overall sense of adaptability and a willingness to be flexible around management practices in order to mitigate the impacts of climate change and adapt to changing conditions. According to Muller, Full Belly sees resilience as the primary way to prepare for changing climate conditions.  The following adaptation practices are organized around Full Belly's objectives, with an emphasis on actions taken to maintain or improve soil health.

**Soil health**

Soil health is a critical part of achieving Full Belly's goal of ecological sustainability. Increasingly over the past several years, Full Belly has focused on reducing bare ground, keeping living roots in the soil, and avoiding disturbance. The focus is not on ease in the short-term, but the ability of the soil to function up to its potential. The building blocks of their efforts to maintain and improve soil health include the use of **cover crops** (see Image 3) on every field every season, application of **compost** before each planting, and incorporating rotational **sheep grazing** on approximately 230 acres of the farm. Efforts to maintain or build up soil organic matter promote healthy crops, store carbon in the soil, promote microbial activity, and make the soil more resilient to impacts from drought or floods. Although Full Belly has engaged in long-term efforts to maintain and build soil organic matter and to enhance soil health, it is significant to note that these same practices have climate adaptation benefits. Facing substantial impacts from climate change, it is more important than ever for farms to increase resilience to drought, extreme weather events, and other climate-related impacts.

*Image 3: Summer cover crops are shown in the field on the left. In the middle and right images, farmer Paul Muller holds a cover crop mix which is about to be planted.*

At Full Belly, they continue to experiment with new ways of applying compost and cover crop practices to reduce bare ground and avoid disturbance. Muller explains that traditional ideas about compost and cover crops involve incorporating them into soil. Of traditional applications, Muller says, “Put compost out there, and then you want to get it into the ground as fast as you can so you don’t lose any nitrogen. You get a cover crop in the ground, chop it up fine, get it in the ground and it’ll digest – it does, it works. You can grow nice crops that way. But it’s not a long term strategy for creating more healthy soil ecosystems.” Muller characterizes their experimentation as an exploration of practices that reduce disturbance in order to tap into the dynamism of soil ecosystems that are more ecologically intact. For example, they are experimenting with putting compost on top of the soil instead of incorporating it, and then covering the compost layer with mulch before planting.

For the past few years, Full Belly Farm has also experimented with **no till** and minimum till practices in their winter squash and melon fields. The primary objective of no till practices is improving soil health – enhancing soil structure, supporting healthy soil microbial communities and maintaining high soil moisture – yet the opportunity to store more carbon in the soil and mitigate climate change is an additional benefit. Full Belly Farm is involved in a multi-year experimentation project focused on no till and reduced till efforts with Conservation Agriculture Systems Innovation (more information can be found here). Muller sees the experiments as a constant exploration of what works on their land, “We’re just really still learning.” In one of their fields (pictured below in Image 4), he points out a field of winter squash that is growing in undisturbed soil. Following a tomato crop last season, they re-shaped beds and planted cover crops. In spring, they rolled down the cover crop and moved residue out of the way in order to create space for planting winter squash. The field has been a success so far, and Muller says it is a step in the right direction. “You have to have successes” he says, and fields like this make it easier for them to decide to try the same practices again. One big challenge to implementing no till practices is how to manage weed pressure using methods that minimize soil disturbance. Full Belly is still experimenting with how to best manage weeds in fields that are not tilled in between plantings.

*Image 4: A winter squash bed highlighting their minimum till practices. On the right, farmer Paul Muller shows off healthy soil as a result of reduced disturbance.*

Other minimum till experiments include different combinations of cover crops, compost, and mulch. One difficulty is having the right tools to plant into beds with residue on top. Muller shared how in recent years they have used old parts to assemble several tractor implements to better suit their needs.

*Image 5: A tractor implement made by Full Belly as part of their minimum till efforts. The implement allows them to move cover crop residue out of the way in order to plant without further disturbing the soil.*

Part of Full Belly's soil health efforts is a transition to thinking about water ecologically instead of a more finite view. Instead of only examining how much water a practice uses (e.g. cover crops), they are thinking about how cover crops contribute carbon and sugars to the soil, which in turn allows microbes to be more productive and roots more capable of foraging for water. When discussing cover crop practices in their orchards, Muller says, “Part of the resilience is having root systems that can harvest what they need from the soil instead of us just putting nutrients near the trees.” He says there is extra cost to reducing bare ground and keeping living roots in the soil but they are confident it will pay off long term. The picture below of melons planted into a live cover crop mulch is another example of the variety of minimum till practices Full Belly employs.

*Image 6: Melons planted into a live mulch at Full Belly Farm as part of the no till and minimum till experimentation. The field was cover cropped and subsequently strip tilled to produce planting rows for melons.*

*Table 4: One of Full Belly’s operational goals, challenges to meeting the goal given climate change, and current adaptation practices along with their benefits.*

| **Goal:** Ecological sustainability | |
|---|---|
| **Objective:** Maintain soil health and function | |
| **Challenges given climate change:** Erosion from heavy winds or rain, reduced water availability | |
| **Practice** | **Benefits** |
| **Cover crops** | • Reduction of bare soil<br>• Reduction of windborne soil particles/ better air quality<br>• Increase in soil organic matter and soil carbon<br>• Enhanced soil fertility and nitrogen fixation |
| **Compost application** | • Increase in water holding capacity and water retention in soil<br>• Enhanced soil fertility<br>• Reduction of runoff from synthetic fertilizer/ enhanced water quality<br>• Supports healthy soil microbial communities<br>• Increase in soil organic matter and soil carbon |
| **Sheep grazing** | • Light manure and urine deposition adds fertility to soil |

| | |
|---|---|
| | • Reduces need for tillage by mowing down crop residue and weeds<br>• Can consume reject vegetables that would otherwise be wasted and turn them into protein |
| **No till / reduced till** | • Enhanced soil structure/ improved aggregation<br>• Reduces soil disturbance<br>• Supports healthy soil microbial communities<br>• Increase in water holding capacity and water retention in soil<br>• Reduction of risk to flooding impacts<br>• Less soil compaction |

**Diversification of crops**

In addition to the loss of working hours and other expenses from responding to extreme heat and power outages, there is loss of income from crops affected by heat stress and other extreme weather events. In high temperatures, crops such as corn and tomatoes may fail to pollinate. In the event of a late winter freeze, fruit that has begun to set on trees may be lost. Full Belly sees diversification as a way to adapt to increasingly variable climate conditions. Although Full Belly has been a highly diverse operation for several decades, farmers make choices on a yearly basis to balance loss of income from extreme weather impacts. For example, Redmond speaks of offsetting losses with additional plantings of annual crops, "When we do get one of those late freezes, we're more likely to plant additional melons or another annual crop." Another example of diversity is planting older varieties of wheat that have fallen out of favor. Muller describes how the older varieties did better during a dry summer than varieties that have been bred for yield. Full Belly farmers see diversification as a strategy for long-term economic viability and an insurance policy against crop losses from climate-related impacts.

**Reducing reliance on the electrical grid**

Redmond speaks about the impacts from wildfires and extreme weather events on electrical service reliability at the farm. The farm sees an increase in days of electrical nonservice during periods of high electrical demand, such as periods of high temperatures, high winds, or wildfires. Power outages and rolling brown or blackouts can have severe economic impacts at the farm and running generators is expensive. One approach Full Belly is exploring is generating on-farm electricity to irrigate new plantings. In order to bring irrigation to a 12-acre field that previously did not have electricity to facilitate irrigation, Full Belly installed a set of solar panels which enabled them to plant a new almond orchard. They are also beginning to think about solar installation when designing new buildings at the farm to further increase climate resilience via energy independence.

*Image 7: Solar panels were installed at Full Belly (left) to irrigate a new 12-acre almond orchard (right).*

### (5) Monitoring and Evaluation

Step (5) focuses on monitoring and evaluating the outcomes (success or otherwise) of adaptation practices. Farmers at Full Belly actively engage in a constant process of observation and adaptation. They see experimentation as a necessary part of farming and work to introduce new ideas and improve upon practices to make their farm as successful as possible. Redmond says, "Each year is a new set of variables. There's no formula." On the importance of observation, she adds, "These systems are all great – putting on compost, growing cover crops, grazing animals – but they all require that people become good observers of all the interactions between their crops and the soil and the water they are using." Although Full Belly has been applying compost, using cover crops, and managing grazing for several years, they continue to use these practices because they see benefits for increasing overall resilience in order to mitigate climate change impacts.

For Full Belly, the process of observation is as important as any management practice. Redmond shares there are multiple owners and supervisors engaging in the process of observation and evaluation, which spurs discussion about whether practices are successful at maintaining productivity and contributing to other goals. Each year, they review sales records and examine yield and pricing of crops for each field, and then compare to records from previous years. Pricing can be determined by how the produce looks cosmetically, which is another way to evaluate whether new practices are having a positive or negative impact on production. They also evaluate practices by looking at variations in labor cost. For example, when evaluating no till or minimum till practices, they look at the time spent weeding each field, since weed pressure increases in the absence of tillage. Once they have determined added costs, they weigh the costs against perceived soil health benefits and any benefits to yield or pricing in order to properly evaluate whether to implement a given practice in future seasons.

Full Belly is willing to take risks by experimenting with new practices. Full Belly experiments with new management practices and variations of existing practices every season. Muller explains it as, "Risk what you are capable of risking" while still maintaining the bottom line and running a profitable business. Adapting management practices to the conditions of each season and experimenting with a variety of practices takes a lot of time and people power, which is part of the tradeoff. Planning for long-term resilience involves many tradeoffs, including added costs up front. Muller says it is a process that requires patience, "It takes longer than [1-3 years] to see systems that are more ecologically intact." Ultimately, Full

Belly views farming as a long term tenure-ship of the land and a process of discovering how to make their resources productive, vibrant, and viable over time.

Judith Redmond

Paul Muller

Zeus

For more information on Full Belly Farm, please visit www.fullbellyfarm.com

This case study was developed by the USDA California Climate Hub in partnership with NRCS. The lead author is Emilie Winfield, a graduate student researcher at the USDA California Climate Hub and UC Davis, with input from Steven Ostoja, Director of the USDA California Climate Hub, and Lauren Parker, Postdoctoral Fellow at the USDA California Climate Hub and UC Davis. Thank you to Judith Redmond and Paul Muller of Full Belly Farm for providing information about their operation.

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https://www.climatehubs.usda.gov/hubs/california

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