The Next California

PHASE II: Preparing for Action

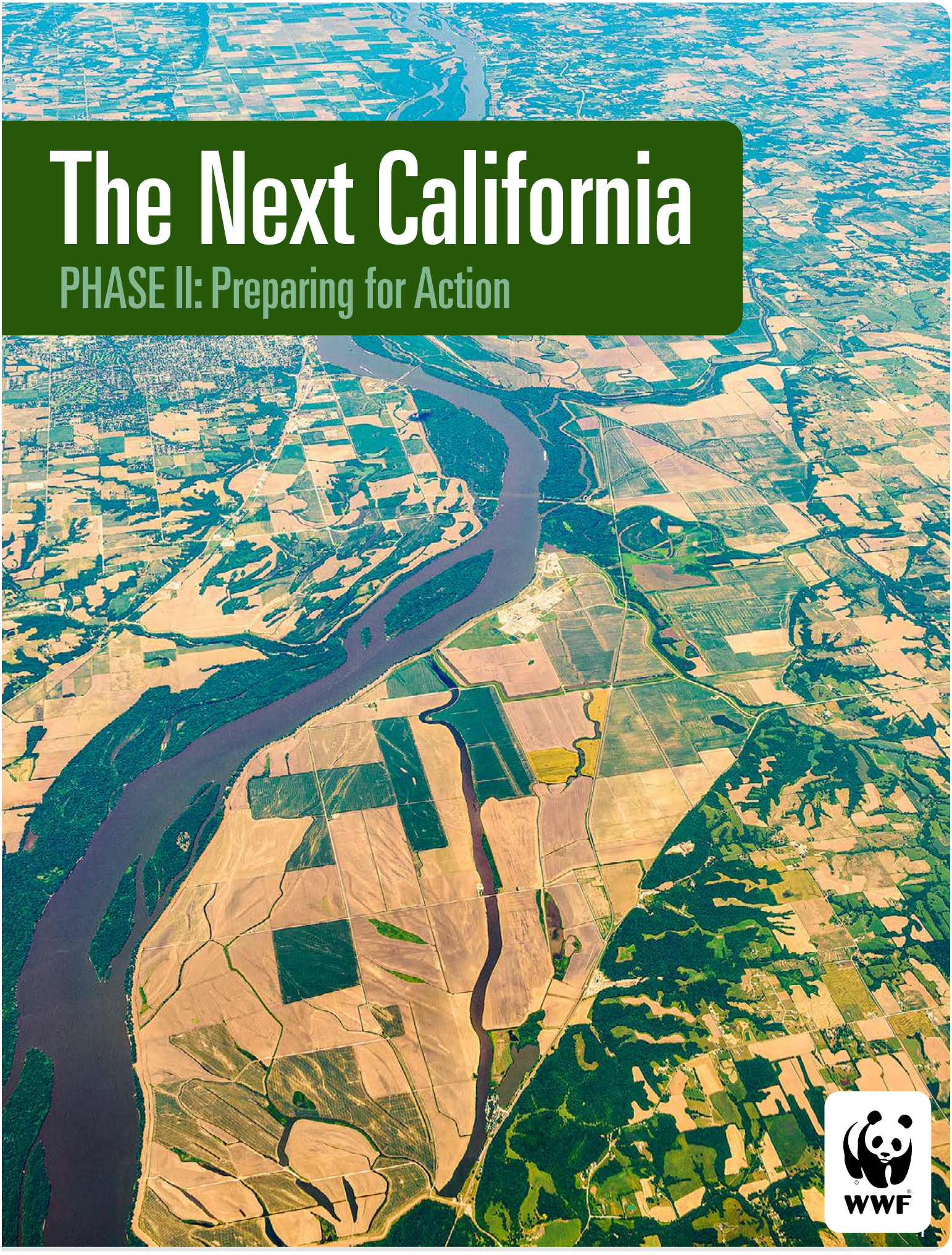

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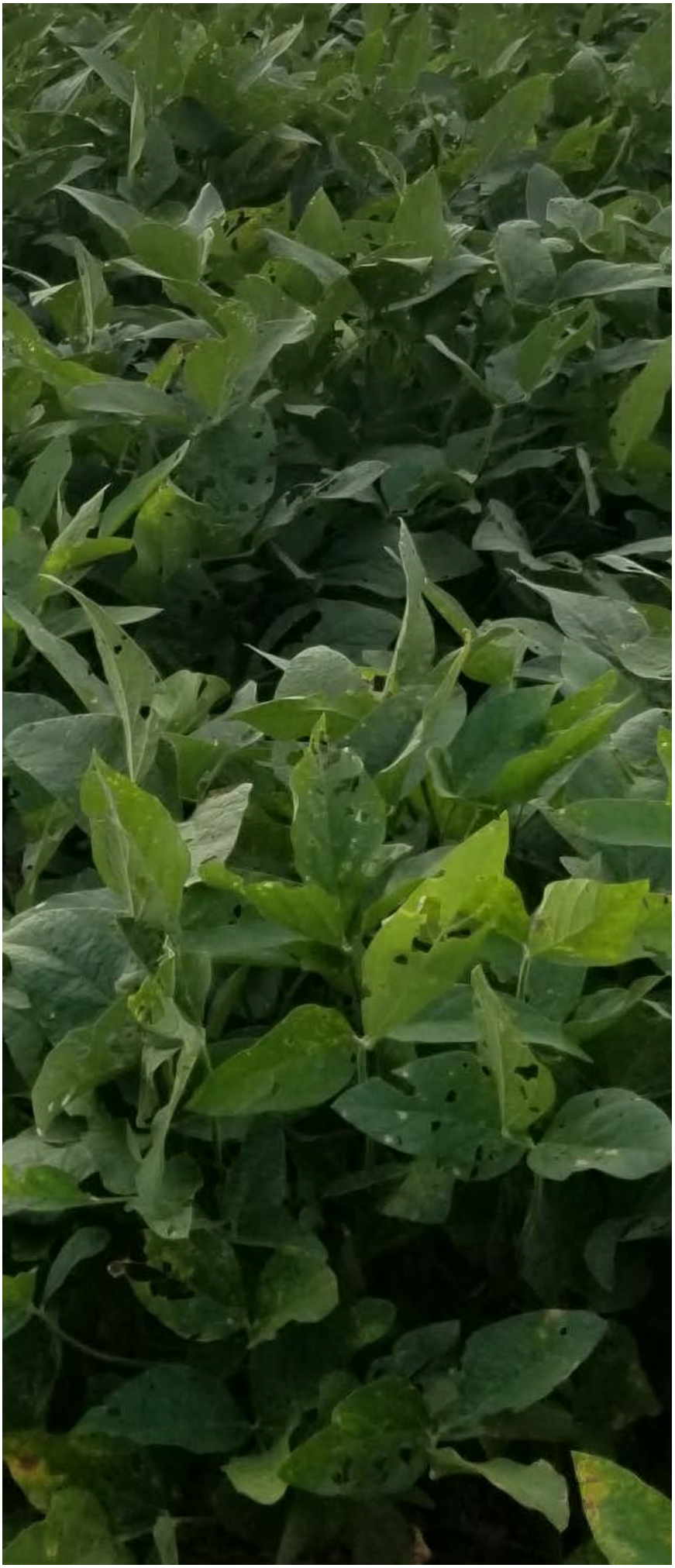
TABLE OF CONTENTS



CONTENTS
APPENDICES

EXECUTIVE SUMMARY

California dominates commercial agriculture production in the US, growing more than two-thirds of fruits and nuts and nearly half of all vegetables, but this is increasingly unsustainable. As the climate continues to change and California sees increasing drought, fire, heat, and other extreme weather events, some food production will need to shift. More than a decade ago, World Wildlife Fund's (WWF's) Markets Institute identified this growing uncertainty in domestic food production as a challenge, but also an opportunity. WWF has been working to build a sustainable and equitable commercial-level specialty crop industry in the Mid-Mississippi Delta (western Tennessee, northwestern Mississippi, and eastern Arkansas) to ease the pressure on California, avoid land conversion (transforming natural ecosystems to farmland) elsewhere in the country, and create an equitable engine of growth in the Delta region.

The Mid-Delta is already a rich agricultural region, largely growing corn, soy, rice, cotton, and wheat. Just 0.19% of planted acres in the Mid-Delta are specialty crops, but they punch above their weight, generating 1.08% of Mid-Delta revenues. This is true nationally as well, with specialty crops making up 1.9% of planted acres across the country but 14.2% of revenues. These additional revenues, along with the local processing, value-added production, and product development that would accompany them, present a real opportunity for the Mid-Delta. But care must be taken to ensure the chance for wealth creation is equitable. US farm ownership by nonwhite farmers has declined dramatically, from 14% in 1920 to under 2% today. And in the Delta, Black-owned farms are only one-fifth the average size of all farms and earn just 33% per acre compared to all farms.

Our Phase I report examined the major opportunities and hurdles of such a shift in the Delta, and this report now presents the culmination of Phase II. During this phase, WWF, in partnership with AgLaunch, convened an Advisory Council of disparate, largely local stakeholders across the Mid-Mississippi Delta, building deep trust and collaboration to tackle the ambitious goals of The

Next California. This Council has met throughout the past 18 months and decided to use the Collective Impact Framework as a guiding process as the project shifts from research to action. In this way, a new organization is not created, but a group of stakeholders working through a common platform agrees on one goal, commits to supporting actions that best align with each organization's skill set, and works towards that goal in a measurable way for a defined period of time. The Advisory Council's shared goals are to: create an audacious and radically different specialty crop industry in the Delta that is grown sustainably, generates wealth creation and prosperity, and builds equitable ownership at all levels from farm to final product. The Council is working on a shared set of metrics focusing on measuring value, wealth creation, and economic development, and each organization has committed to an action in support of these goals.

In parallel to the Council's work, there has also been research into three general areas throughout Phase II:

- Complete background research and lay groundwork for commercial-level production of specialty crops in the Mid-Delta;
- Develop more diverse, equitable, and inclusive business models from production through distribution, processing, and value-added production; and
- Link specialty crop producers, input suppliers, and downstream processors to innovative business models and finance mechanisms.

As the climate changes, production will shift and regions like California will have to make difficult decisions over how to use limited resources. Hardiness zone predictions suggest that the Mid-Mississippi Delta will, in years to come, offer similar hardiness levels as those seen in California today (though with higher precipitation). However, many factors enter and affect the calculation of where crops are grown. The Next California must consider inputs, costs, labor, market opportunities, environmental impacts, and other unintended consequences. Water costs are one of the most significant hurdles facing California farmers today.

An examination of water-to-operating costs as well as analysis of what has grown at scale in the Delta in the past help suggest what crops might be the most likely candidates to shift or scale in the Delta. This includes easier-to-transition specialty crops such as specialty rice, soybeans, corn, and grains that make use of existing knowledge and infrastructure, but also crops like tomatoes, sweet potatoes, okra, peas, pumpkins, peaches, blueberries, melons, muscadine grapes, blackberries, pecans, peanuts, and ornamental crops that have at least some history in the region. For any of these crops, care will need to be taken around increased disease and pest pressures in the Delta's humid climate; growing these crops in the Delta will likely mean increased use of pesticides and fungicides as compared to California. There will also need to be significant infrastructure investments to scale to a commercial size.

Labor (skilled and unskilled) will continue to be a major hurdle. This includes on-farm labor, discussed in more detail in the Phase I report, but also the annual labor that will be needed to support specialty crop production, such as crop maintenance, equipment handling, soil preparation, irrigation management, pest control, and more. The Delta will need thousands of additional workers to match California's annual specialty crop labor force today, as well as additional investment in agricultural technology. However, there is also an opportunity to capitalize on the gap by investing in upskilling, technology production and adoption, and educational initiatives to bring high-level, well-paid jobs to the region in processing and distribution, cold storage, value-added products, and agricultural support services.

It is imperative as this project moves forward that research is completed and provided to farmers and that a strategic approach is taken to supporting this industry – both on farm and through value-added production. For crops, a farm-centric model must be used, enabling farmers to make crop selections and choices that best suit their own land and preferences, while addressing market demand and shifting needs. Increasing specialty crop production offers an economic opportunity,

but also higher production costs, the need for intensive management and consideration of diverse soil types and climate conditions, and the need for post-harvest infrastructure. There won't be a single best answer, but careful consideration is needed at farm-level while offering support at a regional level to provide necessary information. The same care needs to come around value-added products. Local community groups and businesses will need to be provided with key information, too, so that they can also make strategic decisions on investments. In addition, it is necessary to consider the opportunity for new markets and competitive advantages through unique flavor profiles or varietals, geographic indicators, and/or broader regional branding.

We must also consider the potential environmental impact of shifting agriculture, and other unintended consequences. Shifting crop production without proper planning could lead to land conversion, even within the Delta, and its devastating climate and biodiversity outcomes. And, like all other locations, the Delta will see increased extreme weather events and a shifting climate. As farmers invest in these crops, it must be built to be resilient, with precision water systems, water capture and reuse, crop diversification, and other risk reducing factors. There are also risks around market saturation, resource strain, and cultural and social impacts. Strategic planning, research, education, policy, and other tools should be used to mitigate these risks as much as possible from the beginning.

The Next California isn't simply about bringing commercial-level specialty crops to the region, but also using them to generate economic development and wealth creation for farmers and local communities. Innovative equity ownership structures and funding streams, such as co-ops, perpetual purpose trusts, hub-and-spoke models, reverse convertible notes, interest-only loans, social-impact bonds, and more will help place more control and profits with producers and local communities more generally. This stakeholder-centric model also will help create jobs, tax revenue, and local-buy-in and support. There is also an opportunity to use bonds to raise large sums to accomplish social and/or environmental goals with bond ownership and revenues flowing through local communities. While such bonds are still unusual, there are relevant examples to illustrate the possibilities of what could exist as part of The Next California. Even plant seeds and genetics, a traditionally cost-prohibitive business, suggest there may be opportunities through open source, farmer-owned, or regional-specific approaches to increase revenue for farmers while ensuring varietals best suited to the Delta are being grown in the region. There is even a possibility of building on region-specific varietals to create a competitive advantage with markets – a group of stakeholders who will be essential to the success of The Next California.

Buyers of produce, including distributors, retailers, food service organizations, and food companies, are increasingly focused on supply chain security. Over the last few years, they have seen markets disrupted due to COVID, weather events, war, and shipping challenges. Since many of them source heavily from California, they are concerned about what this will mean with changing climate conditions and about largely sourcing from one region with increasingly erratic weather and other events. Buyers are eager to explore new markets and learn more about the possibility of sourcing from the Delta since the risk to California is top of mind, but food safety and consistent supply at affordable rates remains paramount. If these questions can be addressed, buyers are increasingly willing to get involved earlier to build long-lasting supply, such as in The Next California. This would be a change in behavior for most buyers, but by getting involved now some see a chance to build something that supports their own needs and therefore are willing to consider taking on shared risk to help bring that to fruition, through long-term contracts, whole-crop contracts, or even structured investments in a region. Aggregators and infrastructure investments may also play a key role in disaggregating risk, connecting growers and buyers, securing supply chains, and ensuring small and minority farmers can reach markets.

All of the work in Phase II has centered on answering additional questions, building awareness

about the strategy and its potential impacts, and bringing together the needed stakeholders to move into pilots and action on the ground. At the same time, as the ideas have been seeded and work has progressed, individual efforts have already started moving forward. WWF strives to serve as a catalyst, and those efforts are already yielding some results. There have been numerous forward steps by partners, such as AgLaunch's Robotics Consortium, the Arkansas State Department of Agriculture's specialty crop block grant and Arkansas Grown conference, and the University of Arkansas' updated curriculum and Agri-Food Innovation Summit. In addition, there is a chance to highlight and support existing efforts that were already taking place, such as The Natural Soybean and Grain Alliance, Delta Dirt Distillery, and Delta Peanut. We are now also very excited about the launch of Delta Harvest, the first pilot of The Next California.

In January 2024, Hallie Shoffner, a Next California Advisory Council member and a sixth-generation Arkansas farmer, launched Delta Harvest to develop and promote high-quality US-grown specialty rice products. Delta Harvest is working with black and women farmers across the Delta to build a more nutritious, farmer-strong, consumer-centric, and climate-friendly rice industry. It will be building, testing, and demonstrating The Next California goals with an easier-to-transition crop that can bring increased profits to farmers, new markets to products from the region, and more nutritious and environmentally friendly rice to consumers. Delta Harvest will invest in R&D to improve varieties and create seed stock, which it will sell to farmers to build a pipeline of supply. It will also provide technical assistance, storage, processing, and market contracts. Delta Harvest has just secured its first buyer contract and product will be available in 2025.

The Next California now enters Phase III – focused on:

- supporting and launching pilot projects, such as Delta Harvest,
- developing new partnerships and support as the Council members establish and move forward on their own reinforcing activities,
- examining and addressing data gaps that create barriers for farmers today, and
- exploring the potential of branding and a new name, among other activities.

While the impetus for the project has been considering where food production will shift, it is now also about building something new in the Delta – an equitable and sustainable farming system that serves as an engine of economic development.

Significant hurdles remain. This is a risky project and success will require coordinated efforts over years to come. The Next California has set the stage for a radically new farming system in the Delta that supports farmers, especially underserved farmers, boosts communities, increases wealth creation and job opportunities, brings healthy food to the region and beyond, and diversifies and revitalizes the region. The Delta has the opportunity to showcase how transitioning crops thoughtfully can avoid environmental degradation while boosting an economy in an equitable and just manner – an important lesson for countries and regions worldwide.

BACKGROUND AND PHASE I WORK

California dominates commercial agricultural production in the US, growing more than two-thirds of fruits and nuts and nearly half of all vegetables. It is the leading producer of dozens of produce items and the sole producer (99% or more) of almonds, dates, figs, grapes (to be made into raisins), kiwifruit, honeydew, olives, clingstone peaches, pistachios, sweet rice, ladino clover seed, and walnuts. However, between water scarcity, catastrophic wildfires, increasingly extreme weather, and labor challenges, some farms are already shutting down. California will need to make strategic decisions on how to best use its resources. Some food production will need to shift.

More than a decade ago, World Wildlife Fund's (WWF's) Markets Institute identified this growing uncertainty in domestic food production as the climate changes as an urgent challenge. To begin to understand this issue, in 2018 WWF started assessing the potential to proactively shift some production to the Mid-Mississippi Delta region (largely focusing on western Tennessee, northwestern Mississippi, eastern Arkansas but with the same lessons applying to Missouri's boot hill and northeastern Louisiana) to build a more climate-resilient and equitable food system while avoiding land conversion (transforming natural ecosystems to farmland) elsewhere in the country. This work included publishing a Phase I report.

In Phase I, WWF identified several opportunities but also some key hurdles. First, the climates in the two regions are quite different. California's deserts get cool at night, even in mid-summer, and have a very low level of humidity. While the Mid-Mississippi Delta has far more plentiful water, that also means increased humidity and pest pressures – and therefore a greater need for pesticides and fungicides. The Delta also has cooler winters and warmer nights than California. Crops that need "resting time" overnight to grow properly will not be as well-suited to the Delta, but those that need "chilling time" over the winter may be well-suited even with a warming climate. With its higher differential in seasons, the Delta will continue to provide cool temperatures in winter months.

The Delta also brings advantages beyond water and winter temperatures. It is already an agricultural region with resourceful farmers and strong land grant universities and research institutions. While many of these are currently geared towards large-scale commodity row crops, with rice, wheat, soy, corn, and cotton dominating the region, this knowledge infrastructure provides an important base. Climate change is already contributing to a longer growing season. Geographic differences across the region also allow for the production of a wider variety of crops, and there are innovative groups already working to promote specialty crops and their associated economic development opportunities in this region.

Our Phase I report also highlighted hurdles. Shifting to specialty crops would involve switching from largely mechanized crops to those that are still largely tended and picked by hand; therefore, a large increase in seasonal on-farm labor would be needed. These are undesirable and often dangerous jobs and the migrant labor system (H-2A) can be difficult to navigate, leading to hurdles across the system. In addition, farmer/grower education would be needed. While farmers are interested in the benefits specialty crops can bring, it is still a change and would need to be de-risked. There is a lack of specialty crop infrastructure, including cold storage. Drift of herbicides used on row crops could prove tricky, and not all crops growing in California would do well in the Delta.

At the end of Phase I, however, WWF felt that the opportunities outweighed the hurdles. While building a commercial-level specialty crop industry in the Mid-Delta is a vast and risky endeavor, it also has the potential to avoid land conversion elsewhere and presents a unique opportunity to proactively build a system that is far more equitable, focused on bringing economic development gains to the Mid-Delta with a focus on supporting farmers, especially minority farmers, and communities.

This report represents the culmination of Phase II, launched in September 2022. During this phase, WWF, in partnership with AgLaunch, convened an Advisory Council of disparate, largely local stakeholders across the Mid-Mississippi Delta, building deep trust and collaboration to tackle the ambitious goals of The Next California. This included developing a guiding framework and goals statement. WWF has also worked with partners to complete research around crop varietals, economics, labor, environmental impacts, innovative finance and business models to address equity goals, assess market interest, and de-risk investments.

MID-DELTA FARMING TODAY

WWF has been focusing on the Mid-Mississippi Delta region encompassing 79 counties across Tennessee, Arkansas, and Mississippi as well as ten additional counties in the Arkansas River Valley. WWF started with an existing definition of the Mid-Delta from AgLaunch, but these same learnings and work would apply to Missouri's boot hill and northeastern Louisiana as well. Today, this is a rich agricultural region focusing on large-scale commodity row crops. While the harvested acres in the mid-Delta are comparable to total harvested acres in California's Central Valley, the crops look quite different. Arkansas, Mississippi, and Tennessee agriculture is dominated by soybeans, corn, rice, cotton, and hay with limited forays outside of these major crops. Arkansas grows some peanuts (33,000 acres) and oats (10,000 acres), Mississippi has sweet potatoes (31,000 acres) and peanuts (14,000 acres) and Tennessee still has some tobacco (12,500 acres).[1] There are no other specialty crops of note. In comparison, while California does grow corn, rice, cotton, and hay, it is dominated by the production of a wide variety of fruits, vegetables, nuts, and value-added products.

The Delta, as an agricultural region, also encompasses significant knowledge resources. There are numerous land grant colleges and universities in the region. These include: University of Arkansas and the University of Arkansas at Pine Bluff, Alcorn State University and Mississippi State University in Mississippi, and Tennessee State University and University of Tennessee. There are also research organizations outside of colleges, such as Agricenter International, and many groups in the region dedicated to supporting farmers and the broader farming community. While these are largely focused on commodity row crops, they provide integral knowledge resources that would be difficult to build from scratch.

FIGURE 1: A MAP OF WWF'S FOCUS REGION

The Mid-Mississippi Delta counties are represented in red and the Arkansas River Valley counties are represented in blue.

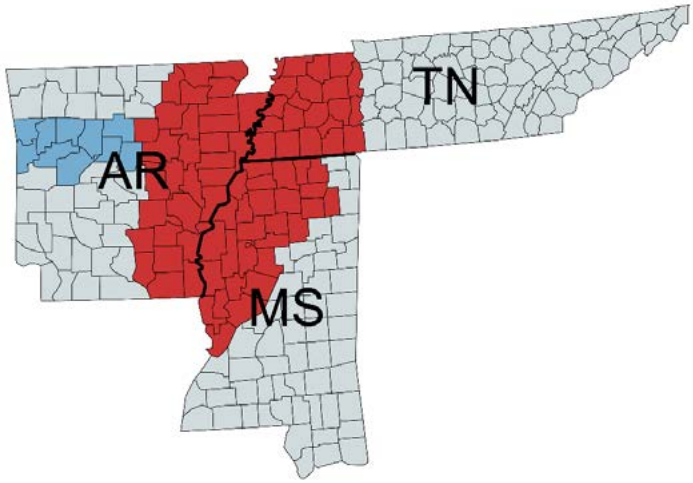


TABLE 1: ACRES OF CROPS IN THE MID-DELTA AND CALIFORNIA IN 2022

	ARKANSAS	MISSISSIPPI	TENNESSEE	CALIFORNIA
Farm operations (acres operated)	13,700,000	10,300,000	10,700,000	24,000,000
Soybeans (harvested acres)	3,140,000	2,290,000	1,620,000	
Corn (acres)	710,000	580,000	830,000	360,000
Rice (acres)	1,080,000	86,000		252,000
Cotton (acres)	625,000	525,000	325,000	132,500
Hay (acres)	1,093,000	580,000	1,672,000	860,000

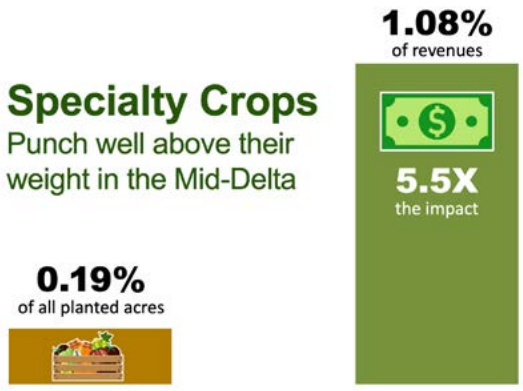
Source: 2022 USDA Agricultural Census

[1] *USDA 2022 Agricultural Census*

Specialty Crops

While there are few specialty crops in the mid-Delta, they often punch above their weight. There are 35,310 farms across the 79 counties we have identified as our target region in the Mid-Mississippi Delta covering 16.4 million acres. Fruits, vegetables, and nuts make up just 31,261 acres in the region (0.19% of acres) but produce $84 million in revenues (1.08% of revenues) a 5.5x impact.[2]

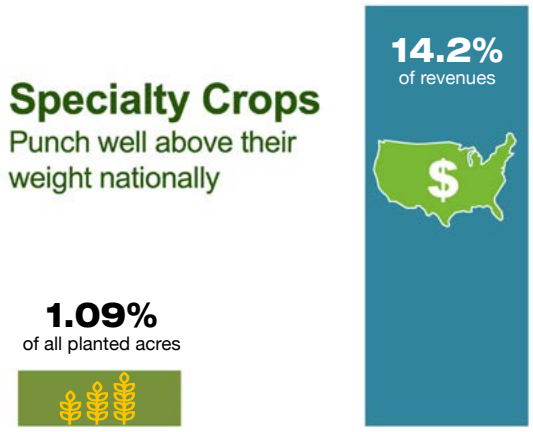
FIGURE 2:
SIZE AND VALUE OF SPECIALTY CROPS IN THE MID-DELTA



This is true nationally as well. Vegetables, fruits, and nuts make up 4.8 million acres nationally, compared to 248.8 million acres of commodity row crops, or 1.9% of total non-animal farmland. However, these specialty crops generate $33.2 billion in market value compared to $201 billion in market value of row crops, or an oversize 14.2%. This is a more than 7x return. Nationally, specialty crops have an average revenue of $6,929.23 per acre compared to $808.26 per acre for commodity row crops.[3]

Since specialty crops make up such a small percentage of all cropland, just a very small shift in crops produced in the Delta could avoid land conversion elsewhere in the country and bring significant economic gains to the region. The numbers above do not account for the revenues and jobs that would also be created through local processing, value-added production, and product development that could be built in the region if specialty crops were grown at a higher level. AgLaunch estimates that even at a conservative level, these add-ons could lead to another $4.6B in added revenues and 33,000 jobs.

FIGURE 3:
SIZE AND VALUE OF SPECIALTY CROPS NATIONALLY

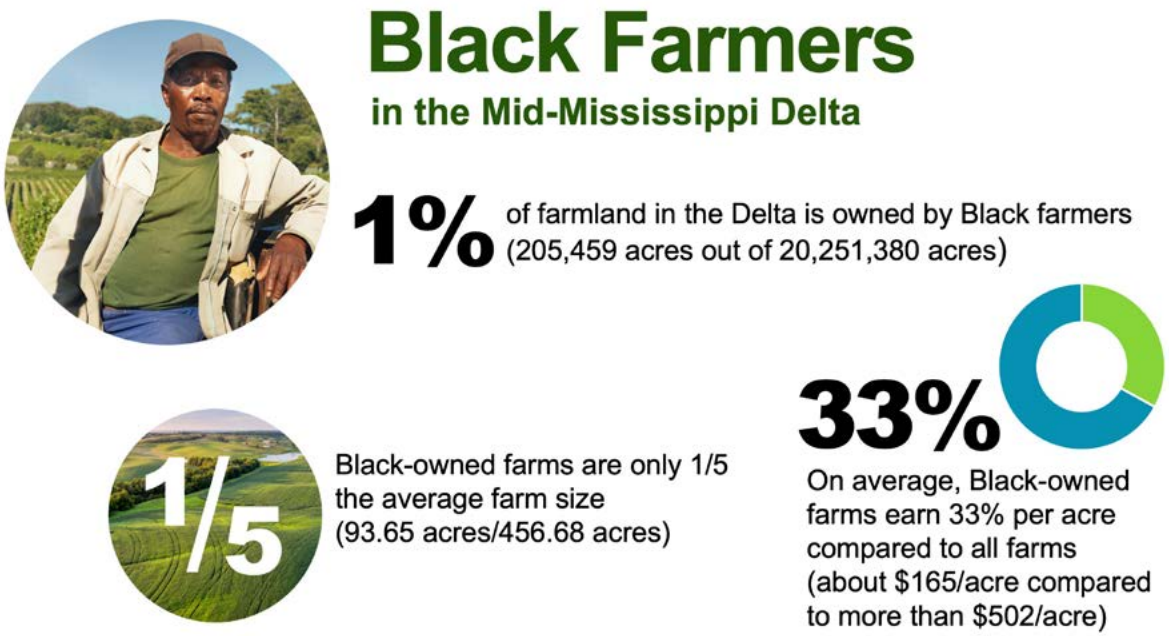


[2,3] *USDA AMS and USDA NASS*

Racial Equity in Agriculture

Unfortunately, racial inequity remains a rampant problem in agriculture today. In the Delta, Black farmers own just 1% of farmland. And, Black-owned farms are only one-fifth the average farm size and earn just 33% per acre compared to all farms. This is similar in the Arkansas River Valley, with Black farmers owning only 0.6% of farmland, with farms three-fifths the size on average and revenues just 21% per acre compared to all farms.

FIGURE 4: SIZE AND REVENUE OF BLACK-OWNED FARMS IN THE MID-DELTA

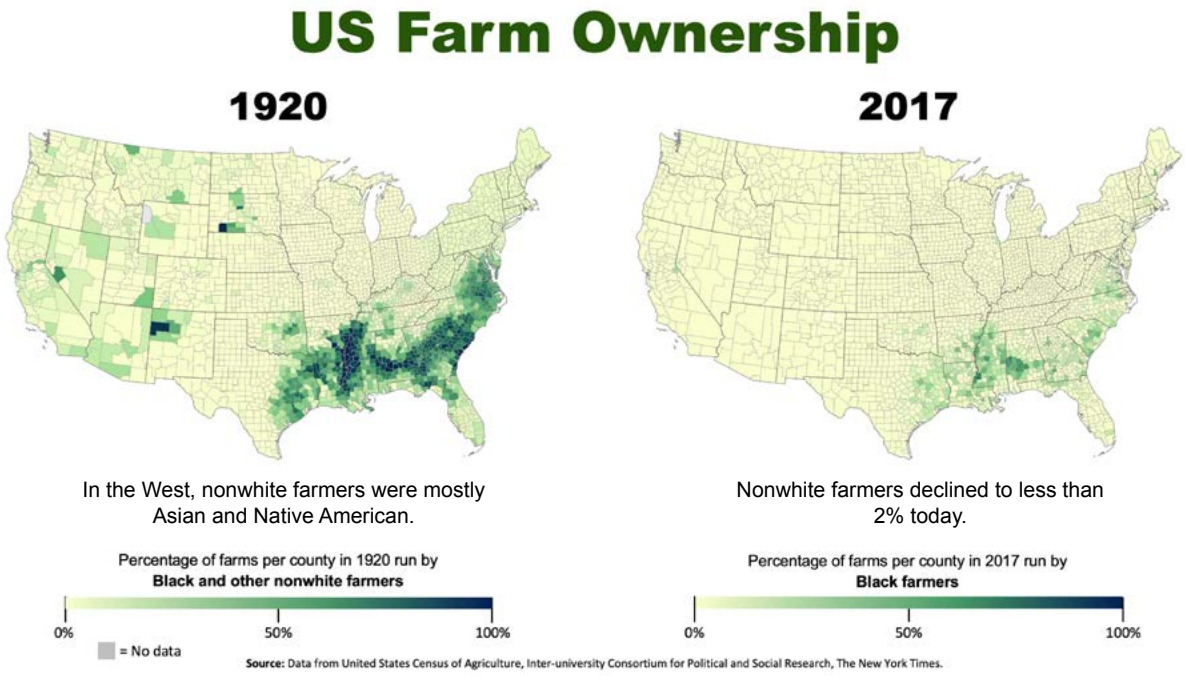


Women farmers also face hurdles but are still doing well. Just 38% of farmland in the Delta is owned by female farmers and these farms are just three-quarters the size of all farms. However, women farmers earn 103% per acre compared to all farms. With an aging farmer population, many of these women farmers may also be widows rather than primary farmers over time, glossing over hurdles women farmers may face.

This inequity isn't limited to the Mid-Delta. US farm ownership by nonwhite farmers has declined dramatically, from 14% in 1920 to under 2% today.[4] The map below shows this stark decline – and that most Black farmers remaining in the country today are in the Delta. County-level data from 1920 was only available for nonwhite farms, not for Black farmers alone, but Black farmers operated the vast majority (98%) of nonwhite farms that year, especially in the South.

[4] *USDA Census of Agriculture*

FIGURE 5: DECLINE IN MINORITY-OWNED FARMS FROM 1920-2017



The decline in Black farmers is due to myriad reasons, but a leading one includes insecure land tenure. This is the single leading cause of involuntary land loss among African Americans and much of it is due to the problem of heirs' property. This is the legal term for land that is owned by two or more people, usually people with a common ancestor who has died without leaving a will. Land continues to splinter over generations, leading to large numbers of people collectively owning the land. Many may not even be aware that they own land tied up in heirs' property. However, this leads to significant hurdles, including lack of access to resources and an ability for land to be suddenly lost.

The lack of a clear title dramatically limits opportunities for land management, often making sale a best option. Owners of heirs' property cannot use their property as collateral for loans, making it much harder to access credit. Heirs' property land also isn't eligible for land improvement programs offered by federal and state governments or even FEMA funds after a natural disaster, something likely to increase with climate change.

Heirs' property is also at risk from a Partition Action. Since all of the land is jointly owned as opposed to each heir owning a specific section of the land, a single owner can force the sale of all of the land, leading to displacement of families. Taken together, all of these actions lead to wealth diminution for families, exacerbated over time, instead of the more typical wealth aggregation seen with long-term land ownership. And, this problem is widespread. An estimated 30-40% of southern Black-owned land is owned through heirs' property.[5] The USDA estimates that 4.7-16 million acres of land were lost through heirs' property over the last hundred years[6] and that 3.5 million acres worth more than $28B are still currently owned in this way.[7]

In addition to land ownership, there is also inequity in land grant universities. In 1862, the Morrill Land Grant Act gave states public land to be sold or used for profit with proceeds put towards establishing a college teaching agriculture and the mechanical arts. While these 1862 land grants were required to integrate to get federal funds, most states instead legislated new colleges for Black students rather

[5] *Gaither, Cassandra Johnson and Stanley J. Zarnoch. Unearthing 'dead capital': Heirs' property prediction in two US southern counties. Eslevier.*
[6] *USDA National Agricultural Library: Heirs' Property. https://nal.usda.gov/farms-and-agricultural-production-systems/heirs-property*
[7] *Presser, Lizzie. Their family bought land one generation after slavery. The Reels brothers spent eight years in jail for refusing to leave it. ProPublica: July 15, 2019.*

than integrating the programs. Ultimately, this led to additional legislation, the 1890 Morrill Land Grant Act, that created "1890" land grant universities, or historically black universities and colleges being established as land grant schools. Instead of land, the federal government provided annual appropriations to each state to support land grants, stating that the funds should be divided in a "just" but not necessarily equal manner. Ultimately, in 1994, the Equity in Educational Land-Grant Status Act was passed that provided land-grant status to some Native American tribally-controlled colleges and universities.

The disparities created at their beginning persist today, with very different funding streams for 1862s and 1890s. Today, 1862s are given annual federal appropriations with a requirement for states to provide dollar-for-dollar matching funds. Meanwhile, 1890s need to find their own one-to-one matching from non-federal sources to release federal appropriations, though there is some ability for waivers to be granted above 50% matching. This need to secure matching funds means that many 1890s are not able to fully secure the federally appropriated funds. In 2020, nine of nineteen 1890s did not receive their full allotment due to the lack of matching funds, a loss of $21M out of $117M available in total.[8] These disparities mean that 1890s are not able to offer the same research services and resources to area farmers as those offered by 1862s.

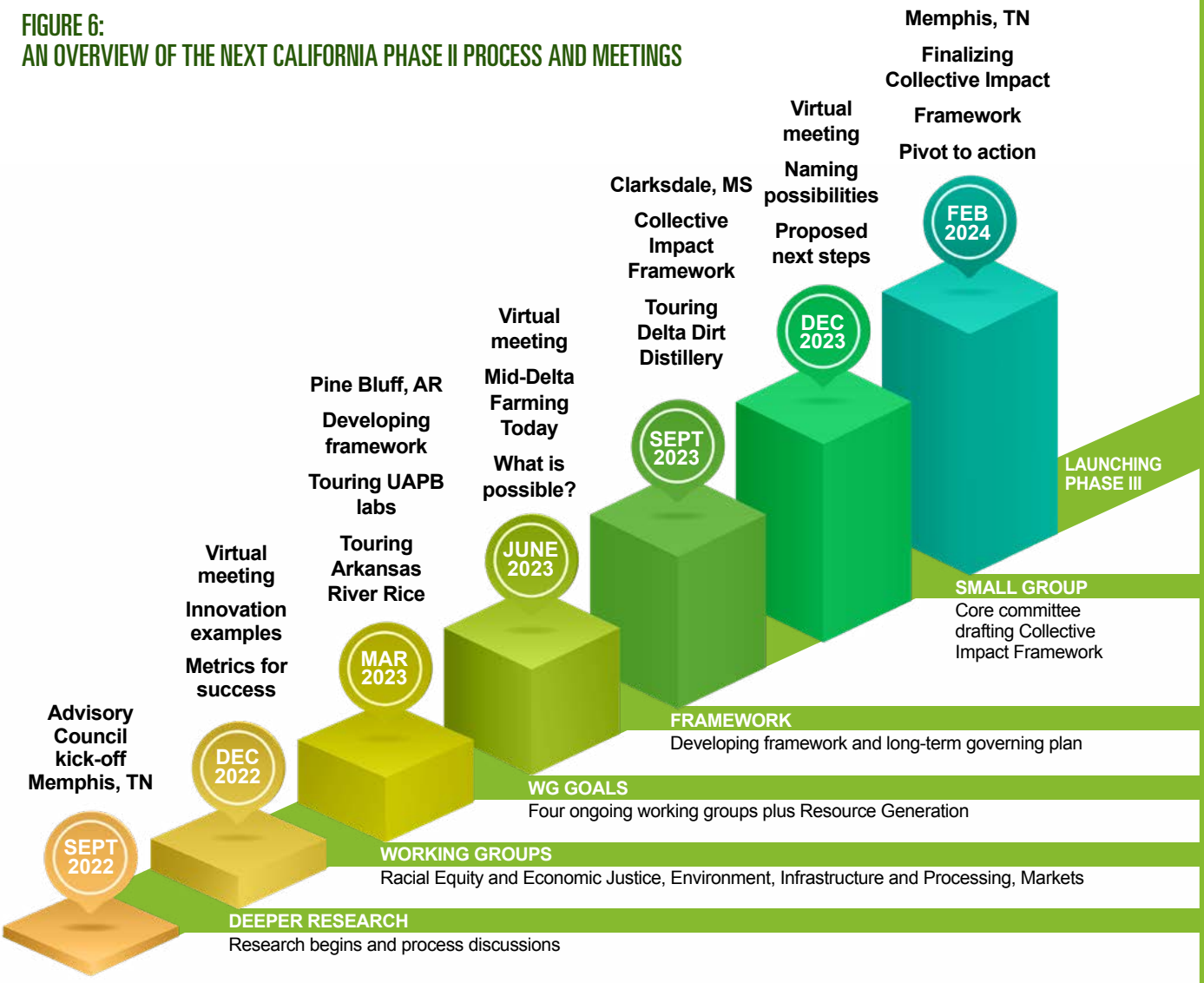
[8] *A Looming Crisis for HBCUs? An Analysis of Funding Sources for Land Grant Universities. NEA Research Land Grant University Brief No. 20. National Education Association.*

OVERVIEW OF PHASE II PROCESS

If the goal of Phase I was to determine if a 'Next California' in the Mid-Delta would even be possible, the goal of Phase II has been to figure out how to make it happen by answering additional questions, completing additional research, and building the connections and stakeholder support needed to prepare for action. All work done throughout Phase II has been towards the goal of building and expanding commercial operations that help transform food production in the Mid-Delta to be more sustainable and resilient in all ways.

To inform and guide our work, we convened an Advisory Council of stakeholders across the region (see *Appendix A*.) This group has met quarterly, alternating in person and remote meetings, throughout the duration of Phase II. Smaller working groups met between meetings, guiding actions and providing feedback throughout the process. The Advisory Council made use of in-person meetings to also visit and tour key sites, including University of Arkansas Pine Bluff's agriculture labs and initiatives, Arkansas River Rice, the only Black-owned rice mill in the country, and Delta Dirt Distillery, a young company creating sweet potato vodka, among other spirits, from sweet potatoes grown on the family's farm.

FIGURE 6:
AN OVERVIEW OF THE NEXT CALIFORNIA PHASE II PROCESS AND MEETINGS



Five working groups were created to continue work between meetings:

- Racial Equity and Economic Justice
- Environment
- Infrastructure and Processing
- Markets
- Resource Generation

Each working group developed a short-term goal by the end of Phase II as well as blue-sky language documenting long-term success. These groups allowed Council members to engage more deeply in areas of most interest and provided valuable guidance to ongoing research efforts and project steps. These groups continue to serve as a sounding board for actions, and a general small committee was also created towards the end of Phase II to help draft a governing structure for the Council moving forward, which was presented for feedback and further updates at the last Phase II meeting, in February 2024 in Memphis, TN. There is now a draft system, laid out below, but it will continue to evolve over the coming months.

Ultimately, the Advisory Council decided to use the Collective Impact Framework developed by Stanford Business School as a guiding process as the project shifts from Phase II research to the 'on the ground' movement of Phase III. The Collective Impact Framework is defined as "a network of community members, organizations, and institutions who advance equity by learning together, aligning, and integrating their actions to achieve population and systems level change."[9] The framework uses five guiding conditions: a common agenda, shared measurement, mutually reinforcing activities, continuous communication, and backbone support. In this way, a new organization is not created, but a group of stakeholders agree on one goal, commit to supporting actions that best align with each organization's skill set, and work towards that goal in a measurable way for a defined period of time.

Five Conditions for Collective Impact

[9] *Collective Impact Forum. https://collectiveimpactforum.org/what-is-collective-impact/*

At the February 2024 Council meeting, the group completed a draft framework covering these five guiding principles:

Common Agenda

Create a radically different specialty crop industry in the Delta that is locally grown, more sustainable, generates wealth creation and prosperity, and builds equitable ownership at all levels from farm to final product.

Our values:

Work towards the creation of regional food systems and economies that uphold our core values:

- Racial equity – ensures Black farmers are a key part of a new farming ecosystem,
- Economic justice,
- Environmental justice,
- Fair labor practices,
- Focus on nutrient dense and culturally relevant produce, and
- Avoid land conversion both in the region and elsewhere in the country while creating economic conditions that support environmental resilience and regenerative farming practices.

Shared Measurement System

The Advisory Council put together a draft set of metrics, but this is still a work-in-progress that will continue to be finalized over the next few months. In general, the group agreed that there should be a focus on measuring value, wealth creation, and economic development as opposed to farms and crops. The current proposed set of metrics includes:

- Value of specialty crops being sold from the region, broken out for historically underserved farmers
- Infrastructure and processing plants for specialty crops in the Mid-Delta, broken out for those where farmers, communities, or workers have ownership
- Unique ownership structures and value creation for farmers, broken out for historically underserved farmers, in the Mid-Delta
- Retailer interest and commitments:
  - Touchpoints and conversations, visits, and tours
  - Exchange of samples and analysis of products
  - Commitments to purchase from the Mid-Delta (including pilot runs)
  - Interest and investment in additional support systems such as long-term contracts
  - In-kind support, including connections to funds, access to infrastructure, and establishing sustainability baselines
- Increased access to and receipt of funding and financing for historically underserved farmers
  - Lower interest rates for farmers
  - Increased knowledge of specialty crops at community banks so they can best consider risk
  - New funders investing in the region and non-traditional finance mechanisms being used
- Research dollars in the region dedicated to specialty crops and the specialty crop supply chain
- Jobs created and wage increases across the region for farm-associated positions (e.g. jobs at processing centers, crop support systems, etc.)
- Avoided land conversion and value of carbon credits
- Culturally relevant and nutrient-dense foods being grown in the region

Mutually Reinforcing Activities

Each group or organization participating in the Council (see *Appendix A* for Council members in Phase II) continuing into Phase III has committed to its own action in line with its own organizational goals and expertise, in addition to the broader activities being taken as a Council. These are still being developed and finalized and will continue to evolve over the coming months. However, some of the commitments made to date include:

- Bringing key partners to the table, promoting awareness, trumpeting existing and new efforts and pilots, and continuing to serve as the backbone for the next year.
- Leading the SBA Regional Innovation Cluster to build diverse networks of innovative farmers to select, pilot, and scale opportunities to lower risk for crop diversity in the region.
- Rallying federal agencies, providing connections and input from Black farmers, and helping connect Black farmers to markets.

- Launching the first pilot bringing specialty rice, grown by Black and women farmers, to market.
- Helping establish farmer networking and support groups and using these to drive policy change.
- Helping design and develop a stakeholder forum, facilitating connections between what is already happening to transform the system to the group, and looking at models that have worked well in the past to support Black farmers and promote equity.
- Building out practices of justice, equity, and sustainability to support the healthy growth and development of this initiative. In the next phase, co-leading and co-facilitating the imagination exercises which will support partners in understanding the practices of justice, equity, and sustainability to show up in the right relationship with all partners in the initiative and the immediate and extended communities we serve. Additionally, supporting the creation of a Mid MS Delta serving endowment that will make impact investments possible to support individual and institutional partners to become a) a truly connected ecosystem, b) build infrastructure, and c) thrive across generations as we transform regional food systems and economies.
- Helping white leaders with racial equity questions to avoid burdening BIPOC members and leaders, examining how the Department of Defense specialty crop program could be a market for producers, and working to educate consumers.
- De-risking the transition to specialty crops for farmer entrepreneurs by sourcing money for research on specialty crops and working to build better connections between farmers and specialty crop research at area universities. Looking into geographic designations to boost regional branding possibilities.

Continuous Communication

For now, the Advisory Council plans to continue to meet quarterly, alternating virtual and in-person meetings, with a smaller group meeting monthly. The Council will continue to establish a proposed length of commitment. The ultimate goal is to create enough momentum that the actions and commercial launches established through this effort take off on their own and demonstrate that this is possible, leading others to get involved without the efforts of the Council. At that point, the Council can continue with its own work, but may not need to continue to come together as a group. This will continue to evolve over the next year or further.

Backbone Support

At the request of the Council, WWF will continue in this role through February 28, 2025, with the goal of then moving to a participant role. Part of the next year will focus on identifying and transitioning to another Council member or members so they are prepared to step into the backbone role for the foreseeable future. Several Council members have expressed interest and the group is discussing options, including whether it should be one or more members.

As the Council shifts into Phase III, its make-up may also change. Up until this point, the group has been in an advisory role. For some members, that may have been most appropriate, and while they will continue to informally advise and support The Next California, they may step back from a more active role as the group moves from individual participation to organizational commitment. There are other groups and individuals who have been a huge asset to the project all along but have been waiting to get involved in a more active role. There are also new partners that will be needed as we move into action. Membership is likely to evolve slightly over the next several months.

In parallel to the Council's work, there has also been research into three general areas throughout Phase II:

- Complete background research and lay groundwork for commercial-level production of specialty crops in the Mid-Delta;
- Develop more diverse, equitable, and inclusive business models from production through distribution, processing, and value-added production; and
- Link specialty crop producers, input suppliers, and downstream processors to innovative business models and finance mechanisms.

The results of that research are included in the following sections.

COMMERCIAL-LEVEL PRODUCTION RESEARCH

As the climate changes, production will shift and regions like California will have to make difficult decisions over how to use limited resources. Hardiness-zone predictions suggest that the Mid-Mississippi Delta will, in years to come, increasingly overlap with the zones in California today (though with increased precipitation which also means a need for increased use of pesticides, herbicides, and fungicides). The growing season will lengthen and winters will become milder – but the Mid-Delta, like everywhere else, will also face increased erratic weather events. However, even beyond climate, many factors affect the calculation of where crops are grown.

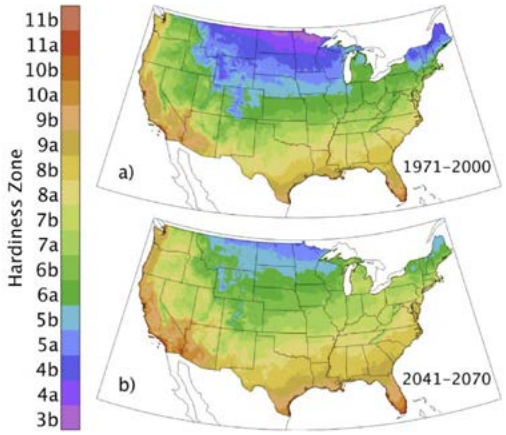


FIGURE 7: COLD HARDINESS ZONES AVERAGED OVER 1971-2000 AND 2041-2070.
From: Parker, Lauren E. and John T Abatzolglou. *Projected Changes in cold hardiness zones and suitable overwinter ranges of perennial crops over the United States.* IOP Science: Feb 24, 2016.

Today, even California is not always well-suited to producing everything it produces, but its benefits (e.g. predictable sun) and intensive farming techniques have attracted growers and created the incentive to try to overcome the hurdles (e.g. lack of water). Infrastructure such as greenhouses and extensive irrigation and other approaches, such as shifting growing over the winter and protecting crops as needed, allow growers to counteract the hurdles and take advantage of the opportunities, though this will become increasingly difficult as water scarcity increases and the climate warms. While hardiness zones and climate will always be a major consideration, it won't be the only one.

As The Next California considers the potential of commercial-level production in the Mid-Delta, we must also consider inputs, costs, labor, market opportunities, environmental impacts, and unintended consequences.

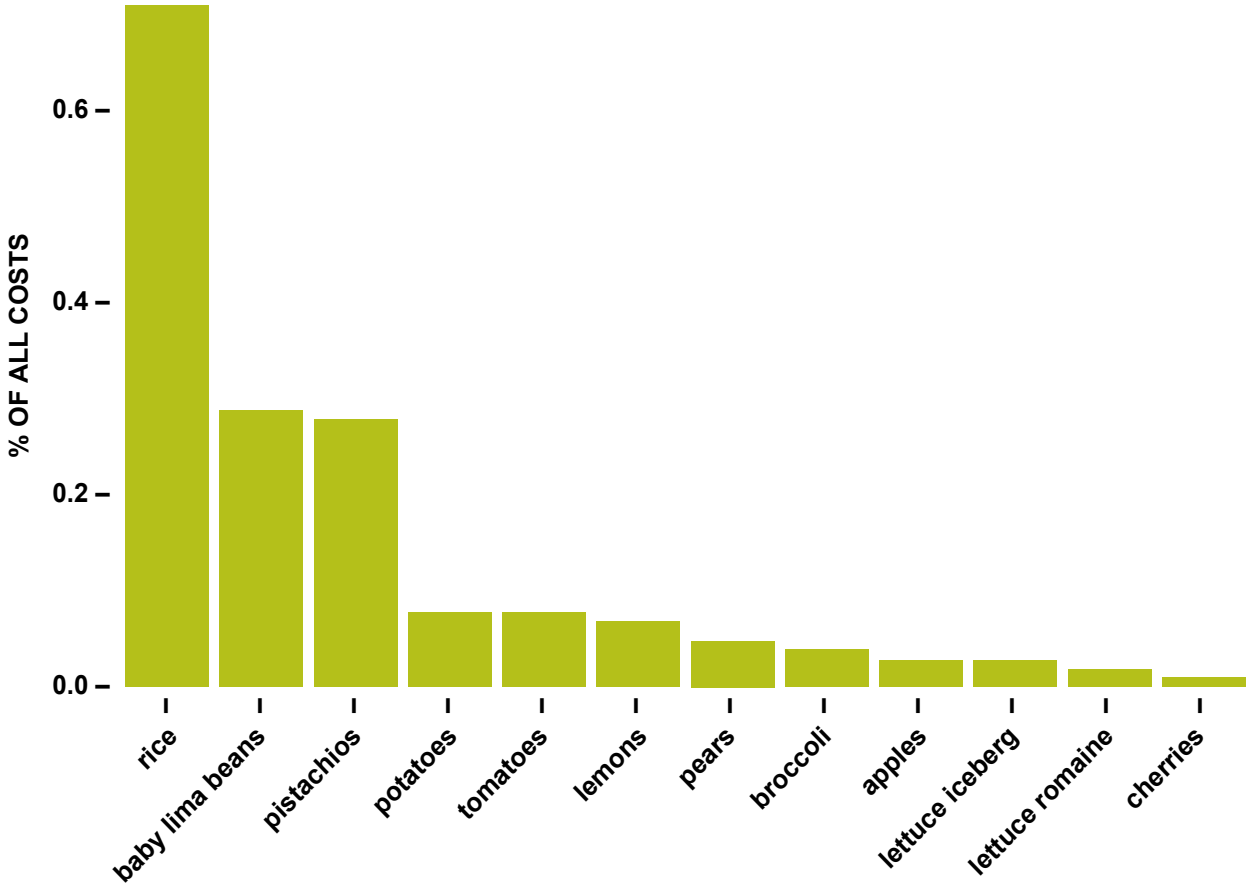
Crop Identification

This section is summarized, excerpted, and adapted from The Next California Project: Phase II – Commercial Level Production of Specialty Crops by Dr. Trey Malone and Courtney Cooper. The full paper is attached in Appendix B.

Even with shifting hardiness zones and climate changes, there will continue to be significant differences in production ecology between the Mid-Delta and California. In order to determine what crops may be most likely to transition, research focused on net returns above total costs and water-to-operating costs. While a crop's total costs (and therefore potential for profits) includes operating and overhead costs, water costs are one of the most significant financial hurdles facing California farmers today. That is only likely to be exacerbated in the future. However, it is important to note that just because a crop may leave California, it may not be well-suited for the Delta.

While Arkansas is already the number one rice producing state, California is number two. Since the Delta is already set up for rice production and rice is such a water-intensive crop, and therefore well-suited to the Delta, specialty rice may be one of the most likely crops to shift to the Delta. The region's high water-holding capacity could be particularly well-suited to jasmine and basmati rice, but the region may also support aromatic, saki, black, red, and sushi rice. Further breeding and agronomic research would be needed to optimize varieties for the region. Post-harvest handling and milling infrastructure may need some modifications, and effective marketing strategies would need to be developed to create awareness and demand.

FIGURE 8: RATIO OF WATER TO OPERATING COSTS



In addition to rice, specialty soybeans (such as edamame), specialty corn (such as popcorn, blue, and sweet corn), and specialty grains (such as quinoa, amaranth, teff, and millet) may do well in the Delta and provide easier-to-transition opportunities that build on expertise in the region.

The Delta also has a history of growing some vegetables, such as tomatoes, sweet potatoes, okra, peas, and pumpkins. The Delta's warm climate would be well-suited to tomatoes as long as disease, which is more likely in humid climates, can be managed. Tomatoes have been grown commercially in the region since the 1920s and Bradley County, AR is famous for its pink tomatoes. There is some existing infrastructure, including packing sheds, but more investment would be needed.

Sweet potatoes, okra, peas, and pumpkins also have a long history in the region. Sweet potatoes do well in the long, hot growing season offered by the Delta but are susceptible to a variety of pests that must be considered and managed. They are also a labor-intensive crop. Okra thrives in the heat and peas are heat-tolerant and are well adapted to the Delta's soils and climate. Pumpkins can also grow well in the region but due to demand around Halloween, careful planning would be needed around growing seasons.

Fruit is likely to pose some of the most significant ecology, infrastructure, and geographic challenges, but there may be a few varieties that are well-suited to the Delta. Mississippi already has blueberry production in the southern part of the state and this high-value crop can grow successfully in the region.

There is already small but increasing blueberry production in Arkansas and Louisiana. However, there will need to be robust cold chain infrastructure and, to capture additional value, processing facilities for freezing or creating other value-added products such as jams and jellies.

Peaches, which need a certain number of chilling hours (32-45°F) over the winter to fruit properly in the spring, are increasingly threatened in California due to its warming winters and may be suitable to transition to the Delta due to its climate and soil characteristics. There is, however, higher risk of disease in the Delta with its high heat and humidity, as well as danger from late spring frosts. Watermelons, other specialty melons, muscadine grapes, and blackberries could also all grow well in the Delta's climate. Just as for the other fruits, though, care will need to be taken around pests and disease and additional infrastructure will be needed.

Pecans, peanuts, and ornamental crops also may all provide opportunities for farmers in the Delta. Pecans can do well in the Delta's heavy, clay soil and peanuts thrive in parts of the Delta with sandy soils. There is some processing in the region, but more would be needed to support a larger industry. Ornamental crops, such as flowering plants, shrubs, and trees used for decorative purposes would all be worth exploring as high-value crops that could offer chances for diversification as well as more unique varietals to consumers.

Labor Needs

This section is summarized, excerpted, and adapted from The Next California Project: Phase II – Commercial Level Production of Specialty Crops by Dr. Trey Malone and Courtney Cooper. The full paper is attached in Appendix B.

While labor consistently arises as the top concern of farmers when switching to specialty crops, it also presents an opportunity. In citing labor, farmers are usually referring to on-farm, seasonal labor, usually filled by migrant laborers. This hurdle was examined in detail in the Next California Phase I report. However, it is also important to consider annual labor that will be needed to support specialty crop production, such as crop maintenance, equipment handling, soil preparation, irrigation management, pest control, and more. The goal of this research was to estimate labor needs and identify opportunities and gaps. There is a significant hurdle. The Delta would need thousands of additional workers to match California's annual specialty crop labor force today, as well as additional investment in agricultural technology. At the same time, there are advantages, such as the Delta's strength in the Greenhouse and Nursery sector, and competitive wage growth in Food Manufacturing. There is also an opportunity to capitalize on the gap by investing in upskilling, technology production and adoption, and educational initiatives to bring high-level, well-paid jobs to the region.

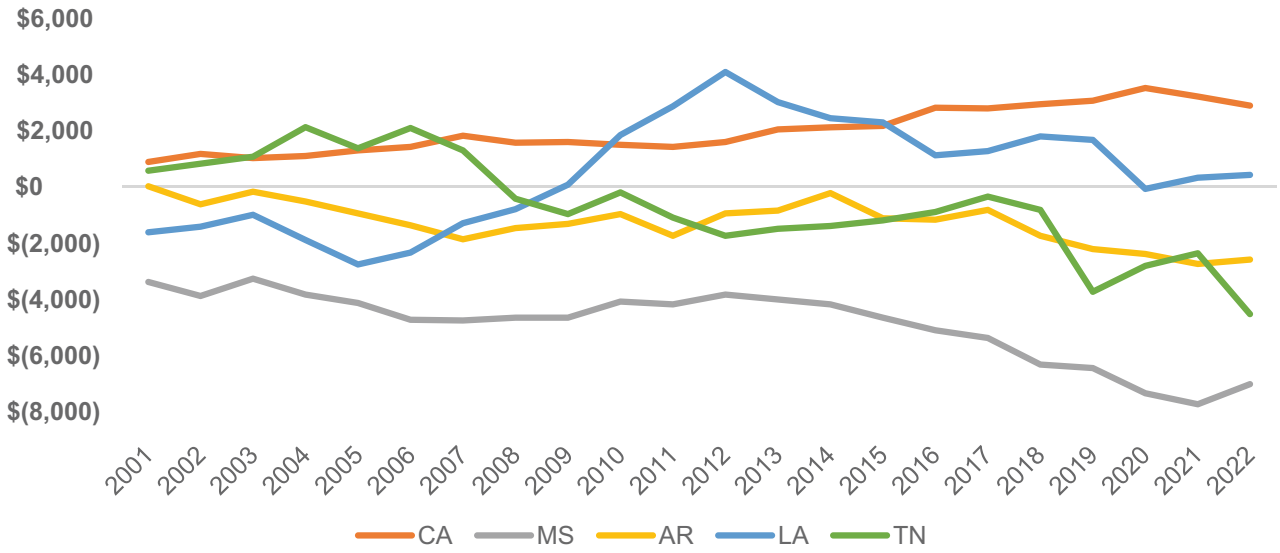
Data from the Quarterly Census of Employment and Wages (QCEW) reveals significant differences in employment in relevant industries between the Mid-Delta and California (Table 2). Even though agriculture is a significant part of the economy in both regions, it is clear that California dominates nationally, likely due to their investment in specialty crops, infrastructure, and agricultural technology. The data also shows a higher investment in processing, manufacturing, and distributing of food.

TABLE 2. PERCENTAGE OF NATIONAL EMPLOYMENT, 2022

NAICS	DESCRIPTION	MID-DELTA	CALIFORNIA
11	Agriculture, Forestry, Fishing, and Hunting	3.2%	33.4%
311	Food Manufacturing	7.7%	9.8%
4244	Grocery and Related Product Merchant Wholesalers	4.5%	13.8%

Wage rates differ little across the regions, with increasing average annual pay in the food system in all states. This is therefore unlikely to be a driving reason to transition to the Delta, but may offer a boost due to lower cost-of-living, taxes, and land prices.

FIGURE 9: CROP PRODUCTION (NAICS 111) AVERAGE ANNUAL PAY RELATIVE TO THE NATIONAL AVERAGE



It is also essential to consider the difference in labor composition between the Delta and California. To examine this, the University of Arkansas team used location quotients (LQ), a statistical way to interpret the relative concentration of an industry in one area to another. This allowed the comparison of percentage of employment between California and Delta. An LQ of one means the sector's share of employment is similar across the two regions. If the LQ is less than one, it demonstrates that that sector's share of employment in the Delta is lower than in California and if the LQ is higher than one, it shows the reverse – that that sector's share of employment in the Delta is higher than in California.

TABLE 3. SELECTED AGRICULTURAL PRODUCTION LOCATION QUOTIENTS RELATIVE TO CALIFORNIA

NAICS	DESCRIPTION	MS	AR	LA	TN	MID-DELTA
111	Crop Production	0.73	0.87	1.09	1.33	0.97
1111	Oilseed and Grain Farming	23.28	32.80	13.60	13.96	22.22
11111	Soybean Farming	1829.84	1204.42	650.87	855.29	1190.19
11113	Dry Pea and Bean Farming	-	-	-	5.67	1.17
11115	Corn Farming	42.76	25.79	34.01	28.70	32.85
11116	Rice Farming	3.62	20.12	5.79	-	8.36
11119	Other Grain Farming	30.12	50.49	14.67	21.87	31.37
111191	Oilseed and Grain Combination Farming	76.51	140.76	33.14	59.22	83.37
111199	All Other Grain Farming	5.39	2.38	4.83	1.96	3.65
1112	Vegetable and Melon Farming	0.38	0.14	0.29	1.16	0.45
111211	Potato Farming	2.86	0.26	1.39	-	1.17
111219	Other Vegetable (except Potato) and Melon Farming	0.06	0.12	0.15	-	0.09
1113	Fruit and Tree Nut Farming	0.03	0.03	0.03	0.04	0.03
11133	Noncitrus Fruit and Tree Nut Farming	0.03	0.03	-	0.04	0.02
111331	Apple Orchards	0.00	0.00	-	3.89	0.80
111332	Grape Vineyards	-	-	-	-	0.00
111333	Strawberry Farming	-	-	-	-	0.00
111334	Berry (except Strawberry) Farming	0.09	0.06	0.00	-	0.04
111335	Tree Nut Farming	0.02	-	-	-	0.01
111336	Fruit and Tree Nut Combination Farming	-	-	0.00	-	0.00
111339	Other Noncitrus Fruit Farming	0.00	-	0.00	0.00	0.00
1114	Greenhouse, Nursery, and Floriculture Production	0.57	0.79	1.79	3.99	1.60
11141	Food Crops Grown Under Cover	-	1.22	0.63	3.63	1.25
111411	Mushroom Production	-	0.00	-	7.37	1.52
111419	Other Food Crops Grown Under Cover	-	1.74	-	2.04	0.95
11142	Nursery and Floriculture Production	-	0.66	2.14	4.10	1.50
111421	Nursery and Tree Production	0.77	0.76	2.62	5.01	2.03
111422	Specialty Canning	-	0.43	0.99	1.87	0.73
1119	Other Crop Farming	2.54	2.32	7.42	2.28	3.45
11199	All Other Crop Farming	-	-	0.78	1.70	0.51
11291	Apiculture	0.89	0.66	1.18	-	0.70
1132	Forest Nurseries and Gathering of Forest Products	-	-	5.64	0.00	1.19
1151	Support Activities for Crop Production	0.19	0.24	0.21	0.13	0.20
115112	Soil Preparation, Planting, and Cultivating	1.24	2.05	1.50	0.33	1.35
115113	Crop Harvesting, Primarily by Machine	0.12	0.13	0.27	0.22	0.18
115114	Postharvest Crop Activities (except Cotton Ginning)	0.20	0.20	0.33	0.09	0.20
115115	Farm Labor Contractors and Crew Leaders	-	0.00	0.03	0.05	0.02

The LQs give a clear view of regional specializations. For example, Mississippi has a soybean farming sector with an LQ of over 1800 and Tennessee has a high LQ in Nursery and Tree Production. However, the Delta states see low LQs in Fruit and Tree Nut Farming and Vegetable and Melon Farming. This represents a hurdle since these industries are nascent, but also an opportunity for growth and development with the proper strategic investment, workforce training, and investment in and improvement of infrastructure.

The full paper in Appendix B provides similar analysis for manufacturing sectors and merchant wholesalers as well as an analysis of how many additional employees would be needed for the Delta's labor force composition to reach the same level as that of California.

It is also important to consider the role of agricultural technology and innovation. Technology can be key for filling labor gaps and also allows a focus on higher-income, more desirable jobs. Due to California's focus on technology and innovation as well as the presence of significant numbers and varieties of specialty crops, it also dominates investment in agricultural technology. Its universities, including world-renowned agricultural research universities like University of California – Davis and University of California – Berkeley are hubs for agritech research and development. California also sees far more private investment in agrifood technology than the Delta. This disparity in investment also carries over to specialty crop support services, such as sustainable farming practices, pest management, and greenhouse operation. Once again, this provides a hurdle in launching a specialty crop industry in the Delta, but also an opportunity to invest in jobs and the economy to use specialty crop production as an engine of economic development across the region – if it can be done with purpose and consideration.

Economic Opportunities and Hurdles

This section is summarized, excerpted, and adapted from The Next California Project: Phase II – Commercial Level Production of Specialty Crops by Dr. Trey Malone and Courtney Cooper. The full paper is attached in Appendix B.

While increasing specialty crop production in the Delta offers an economic opportunity, it also comes with higher production costs, the need for intensive management and consideration of diverse soil types and climate conditions, and the need for post-harvest infrastructure. It is imperative that research is completed and provided to farmers and that a strategic approach is taken to supporting this industry, but that a farmer-centric model is used, enabling farmers to make crop selections and choices that best suit their own land and preferences. Lessons from historical attempts at boosting or creating industries warn against a centrally planned approach, so this research focuses on a market-driven, decentralized strategy that creates institutional frameworks and identifies risks but leaves final decision making to farmers. There will also need to be a parallel approach to providing research and information to local companies to ensure a community-driven approach to value-added processing decisions and investments.

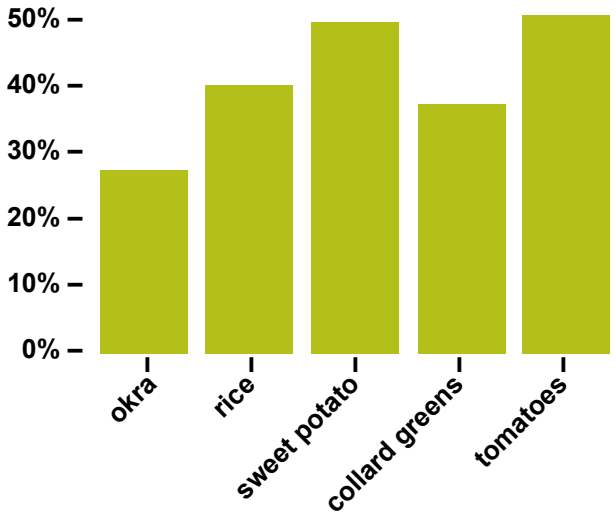
There are significant soil and climate differences between the Mid-Delta and California. Specialty crops tend to require specific soil conditions so large-scale production might necessitate investment in soil health management programs such as crop rotation and cover crops. The Mississippi Delta is an alluvial plain, meaning its soils are predominantly silty clay and silty loams with good water-holding capacity that have been created through sediment deposits over thousands of years from the Mississippi River. These clay soils often have poor drainage, which can mean oxygen deprivation for plant roots. This is quite different than California's well-drained and aerated soils. However, due to its dry climate, California depends heavily on irrigation which has led to issues such as soil salinization and nutrient leaching.

The Mississippi Delta also has a humid subtropical climate characterized by long, hot summers and short, mild winters along with 50-60 inches of rain per year, largely evenly distributed throughout the year. The region is best suited to crops that can withstand or even thrive in humid and moist conditions. In comparison, California's Central Valley has hot, dry summers and cooler, wetter winters and far less rain. The northern Central Valley can see up to 20 inches annually but the southern part gets as little as six inches annually, primarily in winter. Historically, the region saw additional water from melting snow, but snowpack has decreased precipitately due to climate change.

There are also differences in frost. The Delta usually sees frost from December to February whereas the Central Valley sees frost from late November to late February. Since frost can kill or damage sensitive crops, care must be taken if early or late frost is likely to occur. It is imperative to consider these soil and climate differences when selecting crops and making investments in specialty crops in the Delta region.

While these differences present hurdles, they could also present opportunities. Some flavor profiles or varietals might be found that are unique to the Delta and bring a competitive advantage. In a survey of 1,000 US consumers, there was some willingness to pay a premium for certain Delta-Grown products. Sweet potatoes and tomatoes came out best for this.

FIGURE 10: DELTA-GROWN PRODUCTS FOR WHICH AMERICANS WILL PAY A PREMIUM



This may also suggest an opportunity around geographic indicators or region-specific branding. Geographic indicators are most prevalent in Europe (e.g. Champagne, Dijon mustard) and identify products that have a specific geographical origin. To use that name, those products must be grown in a designated region. While less common in the US, there are a few relevant examples, such as Vidalia onions. These can only be grown in a handful of counties in Georgia and provide a market opportunity.

Creating a geographic indication in the Mid-Delta would require an integrated strategic approach with legal and agricultural considerations, starting with identifying a unique specialty crop. This effort would require comprehensive research, organizing and mobilizing farmers, agricultural researchers, and regional agricultural agencies to develop a proposal as well as a marketing and branding strategy building on the Delta's heritage. Since heirloom tomatoes have been cultivated in the region since the 1920s, they might provide an opportunity for a geographic designation. There may also be some opportunities for terroir classifications when broadening to include the Missouri boot hill and northeastern Louisiana, allowing a regional designation rather than a focus on a specific crop.

There is also an option to pursue region-specific branding. This type of branding is often targeted more locally to build on community pride but can sometimes transcend local boundaries. For example, Louisiana-based Jazzmen rice was created to compete with imported jasmine rice and builds on the appeal of a locally grown, high-quality product but is now sold outside of the Delta region. While this approach can be difficult to develop, it can also help preserve a region's agricultural heritage, contribute to sustainability and growth of agri-food systems, and bring a competitive advantage in national or even global markets.

Environmental Impact of Current and Future Specialty Crops

This section is written by Dr. Emily Moberg.

The United States has about 10 million acres of land dedicated to growing orchard, berry, and vegetable crops. Of that land, over 45% is located in California; less than 2% is in Arkansas, Missouri, Mississippi, and Tennessee.[10] Increased temperatures and water scarcity may cause Californian specialty crop growers to use more resources to adapt or to stop producing these crops altogether.[11] This has two potential major problems: (1) increased resource use to grow crops is inconsistent with the need to shrink the footprint of food to keep within planetary boundaries[12] and (2) shifting crop production locations risks native ecosystems' being converted into cropland—with devastating climate and biodiversity outcomes. Concurrently, less than 15% of Americans eat enough fruits and vegetables, indicating that production has a strong mandate to increase.[13]

As hardiness zones shift and large-scale specialty crop production is considered in the Delta, it is important to first explore the environmental costs associated with specialty crop production currently in the Delta Region and in California, and then two contrasting future scenarios: unplanned shifts of specialty crops (see *Unintended Consequences*) and shift of specialty crops to the Delta Region.

The current agricultural landscape in the Delta Region is dominated by row crops. Across Arkansas, Mississippi, Missouri, and Tennessee, the main row crops are corn, cotton, rice, soybeans, and wheat. Table 4 summarizes the environmental impact intensity for four key impact areas for each crop, compared to the impact intensity for the US as a whole. Note that the impacts for these crops for the Delta are typically similar to the US average, except water use for cotton where the Delta's footprint is much lower. The Delta impact intensity is not consistently either higher or lower than the US average.

TABLE 4: PRODUCTION AMOUNTS AND AREA FOR KEY DELTA CROPS, AND ENVIRONMENTAL FOOTPRINTS WITHIN THE DELTA AND FOR THE USA (IN PARENTHESES).

	PRODUCTION AMOUNT	AREA HARVESTED	GHG (USA)	WATER USE (USA)	LAND USE (USA)	EUTROPHICATION (USA)
Corn	888	5	0.4 (0.3)	0.0 (0.1)	1.4 (1.0)	0.003 (0.002)
Cotton	4	2	3.0 (3.5)	0.5 (3.7)	9.5 (12)	0.011 (0.012)
Rice	104	1	0.4 (0.4)	0.8 (1.0)	1.3 (1.3)	0.004 (0.003)
Soybeans	652	13	0.4 (0.5)	0.2 (0.1)	5.1 (4.0)	0.002 (0.002)
Wheat	67	1	0.5 (0.5)	0.0 (0.1)	3.1 (2.8)	0.005 (0.003)

Production data from the USDA NASS for 2017. Production amount in million BU, excepting rice in million CWT; area harvested in million acres; GHG in kgCO2e/kg crop; water use in m3/kg crop; land use in m2/kg crop; eutrophication in kg N/ kg crop. Environmental impact data from Agrifootprint 5.0. Delta values were calculated as a weighted average by production for the Delta states for which there was data. Cotton impacts are per kg cotton lint; wheat impacts are for wheat grain. Data on wheat was for winter wheat in NASS.

[10] *NASS 2017 Specialty Crop report: https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/Specialty_Crops/SCROPS.pdf*

[11] *USDA Climate Hubs: https://www.climatehubs.usda.gov/hubs/california/topic/climate-vulnerabilities-california-specialty-crops Note that 2017 is the most recent year available. 2022 data is expected to be synthesized later in 2024.*

[12] *Gerten, D., Heck, V., Jägermeyr, J. et al. Feeding ten billion people is possible within four terrestrial planetary boundaries. Nat Sustain 3, 200–208 (2020). https://doi.org/10.1038/s41893-019-0465-1*

[13] *CDC Morbidity and Mortality Weekly Review: Adults Meeting Fruit and Vegetable Intake Recommendations –United States, 2019 https://www.cdc.gov/mmwr/volumes/71/wr/pdfs/mm7101a1-H.pdf*

Specialty crops, meanwhile, live up to their name with respect to the variability of how they are grown and the inputs needed. Relative to staple crops, the environmental impacts of specialty crops are far less studied. As hardiness zones shift and large-scale specialty crop production is considered in the Delta, it is important to first explore the environmental costs associated with specialty crop production currently in the Delta Region and in California, and then two contrasting future scenarios: unplanned shifts of specialty crops (see *Unintended Consequences*) and shift of specialty crops to the Delta Region.

The environmental impacts are also very different across the different crops (see Figures 11 and 12).

Crops within the same category (e.g., chestnuts and hazelnuts) often have very different total footprints and main causes of emissions. For example, electricity and fuel use on-farm is a major contributor to some crops' GHG footprints but absent for others. There is also a large amount of heterogeneity for the same crop; footprints across environmental indicators often vary by well over two-fold depending on production practices and geographies.

While greenhouse gas emissions and land use are, for many specialty crops, similar in intensity to those of row crops (see, e.g., Figure 11, corn / maize is shown at the far left), water usage for many of these specialty crops is far greater.

FIGURE 11: COLOR SCALE IMPACT INTENSITY FOR (TOP) GREENHOUSE GASES, (MIDDLE) LAND, AND (BOTTOM) WATER USE BY DIFFERENT STAGES OF PRODUCTION.

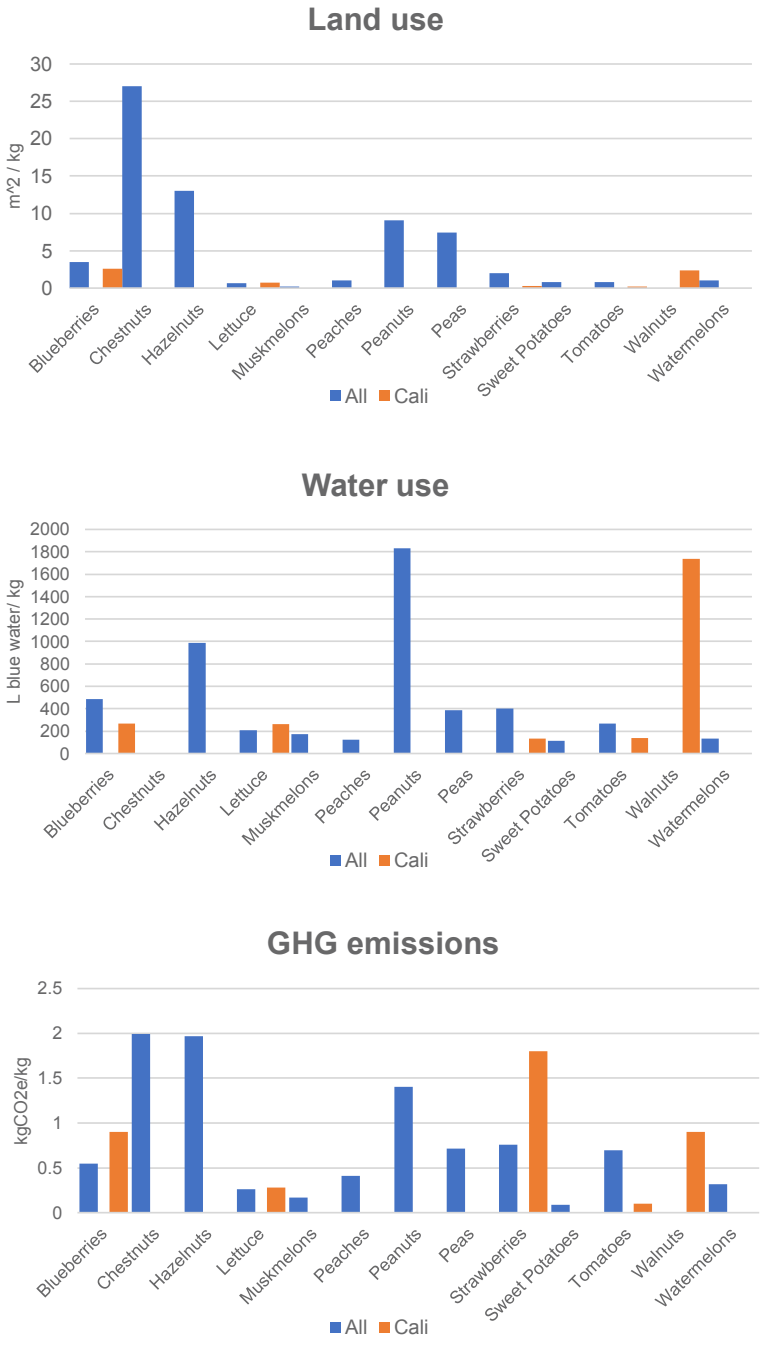
Yellow indicates low intensity; dark purple indicates high and are globally representative. Data from Poore & Nemecek (supra).

[14] *https://www.climatehubs.usda.gov/sites/default/files/specialty_crops_addendum_7_6_2018_final.docx_.pdf*

Data availability for California-specific specialty crop impacts is sparse, although some in-depth studies have been conducted.[14] Figure 12 shows a summary of the Californian impact intensity where data was available, as compared to the international average. Note that there is not a consistent pattern as to whether the intensity from products grown in California is greater or less than the global average. Please note, while the focus is on producing these crops in the Delta, data isn't available for the region due to limited presence of specialty crops so we share California to understand comparative possibilities.

FIGURE 12: LAND USE, BLUE WATER USE, AND GHG EMISSIONS INTENSITY FOR SELECTED SPECIALTY CROPS GLOBALLY (BLUE) AND IN CALIFORNIA (ORANGE)

Note that for many of the shown crops, no footprints were available for California; no data was available for unlisted crops. Data from Poore & Nemecek.[15]

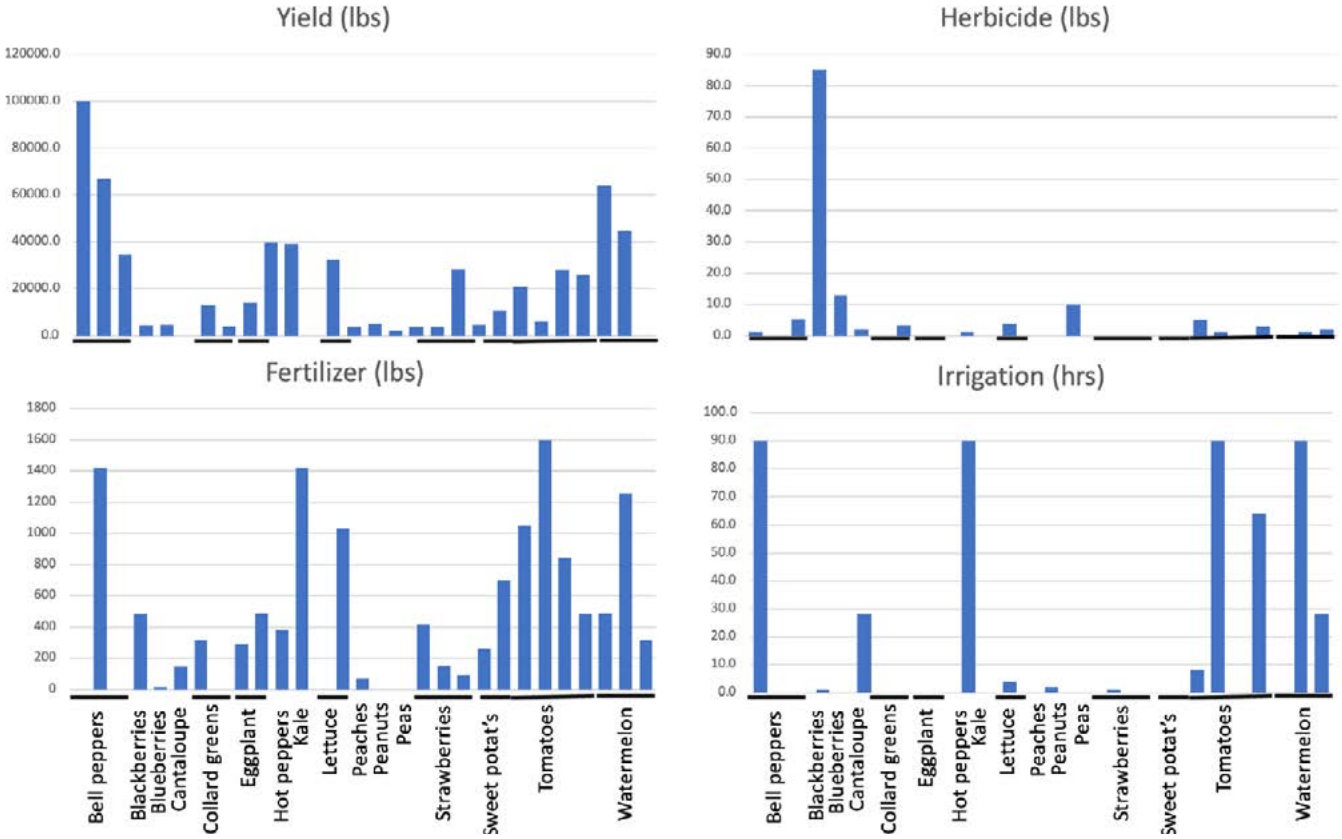


It is worth noting that Californian specialty crop production is almost entirely irrigated, in contrast to the rest of the United States, which has about 65-75% of orchard and berry croplands irrigated respectively.[16]

We estimated the inputs needed for specialty crops in the Delta by reviewing specialty crop budget tools for the four target and neighboring states. In some cases, additional inputs (e.g., peat moss) were listed for a single crop; these were not recorded. For perennial crops, the inputs were amortized across years. For reference, farm budgets for California are also included. The links to the calculator and summary per crop can be found in Appendix C.

[15] Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. Science, 360(6392), 987-992.
[16] USDA NASS Specialty Crop Report 2017 infra

FIGURE 13: YIELD (TOP LEFT) AND INPUTS (AS NOTED) FOR ONE ACRE OF PRODUCTION FOR DIFFERENT SPECIALTY CROPS IN THE DELTA REGION



While the units are often incomparable, it is worth noting that Delta states tend to apply half as much water (17 vs. 33 inches) versus California for all crops (as of 1998). Grain crops generally get between 10-29 inches, while vegetable and orchard crops receive 24-28 inches.[17]

For the few crops where some inputs were comparable (units of measure), fertilizer use per unit production was more often smaller (more efficient) in the Delta than in California. Labor use per unit production was more often larger in the Delta than in California.

Unintended Consequences

This section is summarized, excerpted, and adapted from The Next California Project: Phase II – Commercial Level Production of Specialty Crops by Dr. Trey Malone and Courtney Cooper except where noted. The full paper is attached in Appendix B.

While the possibilities of The Next California are exciting and far-reaching, creating a radically different specialty crop industry in a new region is also an audacious goal with risks, complexities, and potential unintended consequences. It is important to work up front to identify as many potential issues as possible so mitigation strategies can be developed. Some of these challenges include market saturation, resource strain, cultural and social impacts, and environmental impacts both within the region and elsewhere across the country.

[17] *https://www.ers.usda.gov/webdocs/publications/41964/30286_wateruse.pdf?v=41143*

Market Saturation

While the basic assumption is that some production will need to shift out of California so there is an opportunity to proactively move that production in a sustainable and equitable way to the Delta, there is also a real risk that as more producers begin to grow, process, and sell more value-added products, there could be market saturation. As more producers begin to grow specialty crops in the hopes of seeing higher margins, the advantage may decrease. Market saturation would force prices downwards, squeezing profit margins and potentially destabilizing producers who have transitioned to these crops as well as those already growing them.

This risk will be extra prevalent in a region with little diversity of specialty crops. For example, it is possible that multiple growers could start producing the same crops at once, leading to a glut. Competition would commence and prices would decrease.

Careful market analysis, strategic planning, and coordinated efforts are needed to mitigate this risk. Producers could collaborate to manage supply and demand to ensure a fair return on investment in new markets. They could also work with the broader ecosystem to expand the entire market through regional branding, novel distribution strategies, and online marketplaces. Greater diversification of crops within farms and across producers would also mitigate this risk as well as reduce other risks farmers may face, such as catastrophic loss.

Resource Strain

Unlike commodity row crops, specialty crops call for increased equipment, labor, and expertise. If many growers make this shift at once, resources will be even more scarce, prices will rise, and smaller producers might be priced out of the market. While a goal of this project is to elevate and support small and minority farmers, resource strains could instead lead to the opposite. Smaller-scale growers may also be unable to invest in the necessary infrastructure to switch to and scale specialty crops even without added resource strain.

Targeted and innovative solutions are needed to mitigate the potential of resource strain. Financial incentives (e.g. grants, low or interest-only loans), shared facilities (e.g. cold storage, processing centers), and extension services and educational programs focused on small growers would all help to bring access, technical assistance, and capacity to level the playing field. Cooperatives and other innovative business models would also help to reduce risk.

Ongoing education and training as well as access to market research will also be key. This will let growers be more aware of current market dynamics, gain insights into changing consumer and buyer behavior, and cultivate a culture of innovation and adaptability. Finally, access to financial planning and risk management education would give growers the information they need to be empowered to plan for this type of risk.

Cultural and Social Impacts

There is a risk that as the Delta moves towards specialty crops, there could be an inadvertent devaluing of traditional farming practices and products and therefore a loss of cultural heritage. Many farms and traditions have been passed down for many generations and traditional farming practices are often the backbone of rural communities. While the chance at new crops can bring innovation, it can also impact identity and community cohesion. This shift could also exacerbate the already prevalent divide between small-scale farmers and agribusinesses, with small-scale farms less able to invest in the infrastructure and equipment needed for specialty crops. This could lead to further socioeconomic splits and further destabilizing of communities.

The main way to mitigate this risk is to involve the community in the planning and implementation process from the outset. Stakeholders across the region must be heard and have the chance to create a system that resonates with community values and supports community needs. There is a way to balance innovation and tradition and people across the Delta are best placed to plot that process.

Choosing crops and grow systems that resonate with the region's identity and cultivating support networks and shared resources could also help to build a new system based on community identity. Support networks could also serve as collective platforms, allowing small-scale farmers to access more resources. There is an opportunity to design a system that promotes communities and regional identity, but care will be needed to ensure that a new farming system builds upon the Delta rather than eroding it.

Uncontrolled Specialty Crop Expansion
This section is written by Dr. Emily Moberg.

A major goal of this project is to guard against the devastating consequences of climate-induced habitat destruction as farmers shift specialty crop production away from current unsuitable areas of production. One major risk of not undertaking this project is that natural habitats in the Northern West Coast or other areas of the United States or Mexico will be cleared for specialty crop production that can no longer be accommodated in California. Without the measured, intentional approach proposed by this project, natural lands within the Delta region may also be at risk of being converted into specialty crop land.

As the climate continues to change, many agricultural crops are expected to "shift" to new areas as it becomes uneconomical to grow them in their current locations, even with adaptation efforts.[18] Specialty crops, which are often susceptible to pest pressures and singular extreme cold or heat events, may be particularly sensitive to these changing conditions.

Across orchard fruits and nuts, berries, and vegetables, California has over 4.6 million acres of cropland.[19] If even a portion of this cropland shifts, large areas of natural habitat could be threatened.[20] The area at stake could also be much larger, as satellite monitoring of ecosystem loss and cropland expansion shows that up to two-times as much ecosystem is cleared as ends up in agricultural production.[21] This clearing irreparably damages ecosystems and biodiversity.

Which ecosystems are at risk is a function of many factors, including land prices, crop cultivar availability, and adaptation technologies. For the crops studied in this project, we have created maps showing potentially suitable expansion areas overlaid with natural area extent to highlight potential hotspots for future conversion – and therefore what we want to avoid through this project. See Figure 14 and Appendix D: Crop Mapping.

[18]There are many regional predictions across the world for this phenomenon. For example, see Cunningham, M. A. (2022). Climate Change, Agriculture, and Biodiversity: How Does Shifting Agriculture Affect Habitat Availability?. Land, 11(8), 1257.; Bradley, B. A., Estes, L. D., Hole, D. G., Holness, S., Oppenheimer, M., Turner, W. R., ... & Wilcove, D. S. (2012). Predicting how adaptation to climate change could affect ecological conservation: secondary impacts of shifting agricultural suitability. Diversity and Distributions, 18(5), 425-437.

[19]USDA NASS Specialty Crop Report 2017 infra

[20]For context, about 1.6 million acres of native grasslands were lost in the United States & Canadian Great Plains due to row crops in 2021, with devastating ecological consequences: https://www.worldwildlife.org/projects/plowprint-report

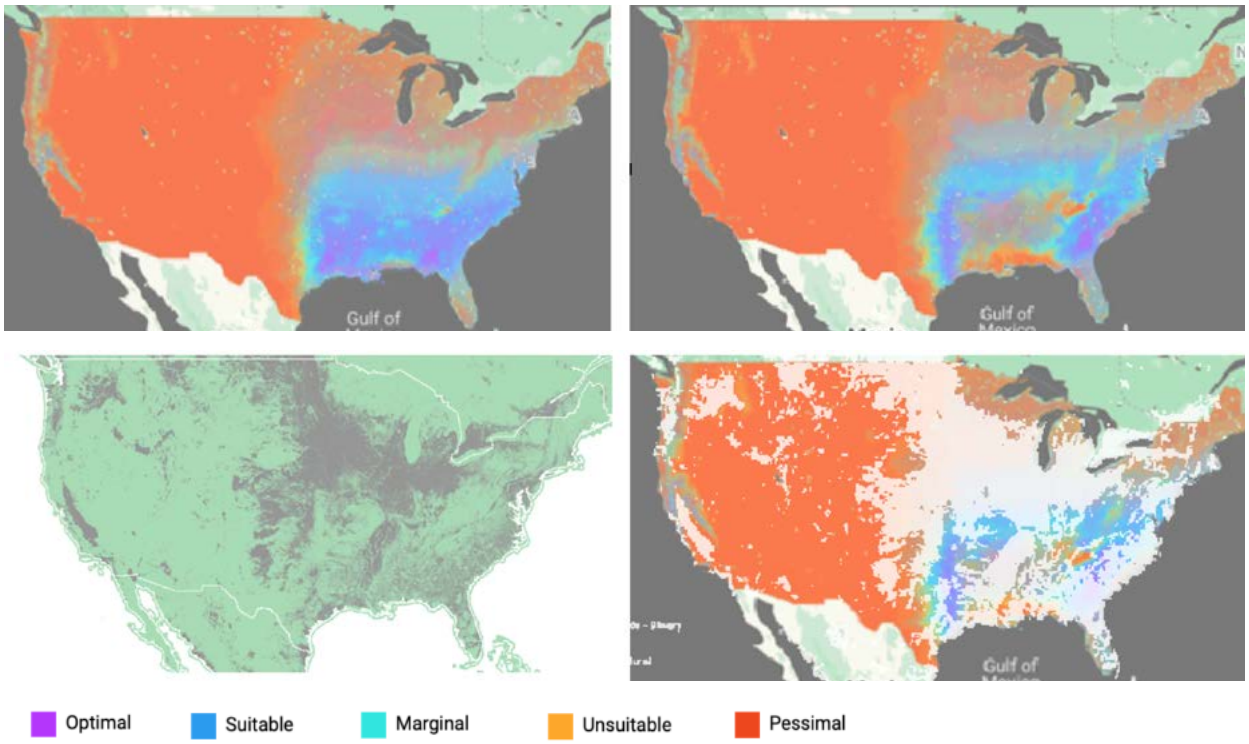
[21]Florence Pendrill et al., Disentangling the numbers behind agriculture-driven tropical deforestation. Science377, (2022). DOI:10.1126/science.abm9267

FIGURE 14: ILLUSTRATION OF NATURAL AREAS NATIONALLY THAT ARE AT RISK DUE TO CROP EXPANSION, UNLESS INTENTIONAL SHIFTS LIKE THAT PROPOSED BY THE NEXT CALIFORNIA ARE IMPLEMENTED

The top left panel shows a composite suitability (key in bottom right) across all 12 months of initial planting for strawberries over the 2005-2010 and the 2015-2020 time period to capture trends in suitability over time.[22]

The bottom left map is the Science Based Targets Network natural lands map; it classifies lands as natural or not as of 2020.[23] *Any lands in green area are currently natural and are lands into which we are concerned about cropland expansion.*

The bottom right map shows the 2015-2020 suitability map masked by non-natural lands. Any area not in white is currently natural lands. Those areas that are in the purple and blue colors may be suitable for growing strawberries and at risk of conversion – which The Next California hopes to avoid. Areas of the West Coast and Deep South appear to be hotspots of potential conversion risk. Appendix D: Crop Mapping contains these maps for all the Next California project studied crops and the underlying data for parameterizing suitability.



Similarly, the net effect of conversion is also highly unpredictable and variable. The necessary habitat extent of different species, the fragmentation of existing habitats, etc. all contribute to the biodiversity impacts of conversion. The type of ecosystem determines the carbon losses that arise from conversion events, while the local hydrology determines the potential impact of lost vegetation on the overall water quality and quantity.

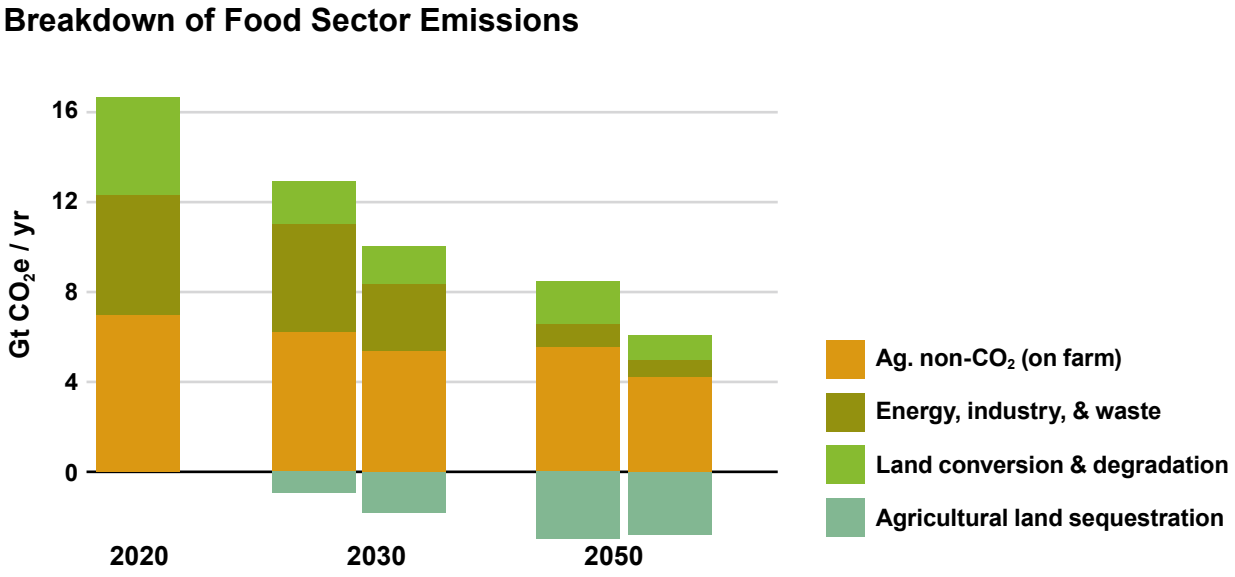
The planetary boundary for biodiversity is no additional cleared lands; for climate change, all commodity-driven conversion needs to stop by 2030 at the latest, so these conversion risks fall well outside these allowable thresholds (see, e.g., Figure 15 which illustrates the environmental importance of avoiding land conversion).

[22] *Crop suitability tool from Peter, B.G., Messina, J.P., Lin, Z. et al. Crop climate suitability mapping on the cloud: a geovisualization application for sustainable agriculture. Sci Rep 10, 15487 (2020). https://doi.org/10.1038/s41598-020-72384-x was used to generate maps. FAO's ECOCROP database https://gaez.fao.org/pages/ecocrop-find-plant was used to parameterize the model with precipitation, temperature, and growing season limits.*

[23] *https://www.landcarbonlab.org/news-updates/natural-lands-map-companies-no-conversion-targets*

FIGURE 15: AN EXAMPLE OF A PLANETARY BOUNDARY FOR CLIMATE

The first bar shows the 2020 emissions for the food system. The bars for 2030 and 2050 show the 2 degree and 1.5 degree limits. Note that emissions from land-conversion (dark green) represent about a third of current emissions and they need to decline especially for 1.5C futures. Any remnant conversion is reserved for smallholder, subsistence agriculture.[24]



Environmental Impact in the Delta

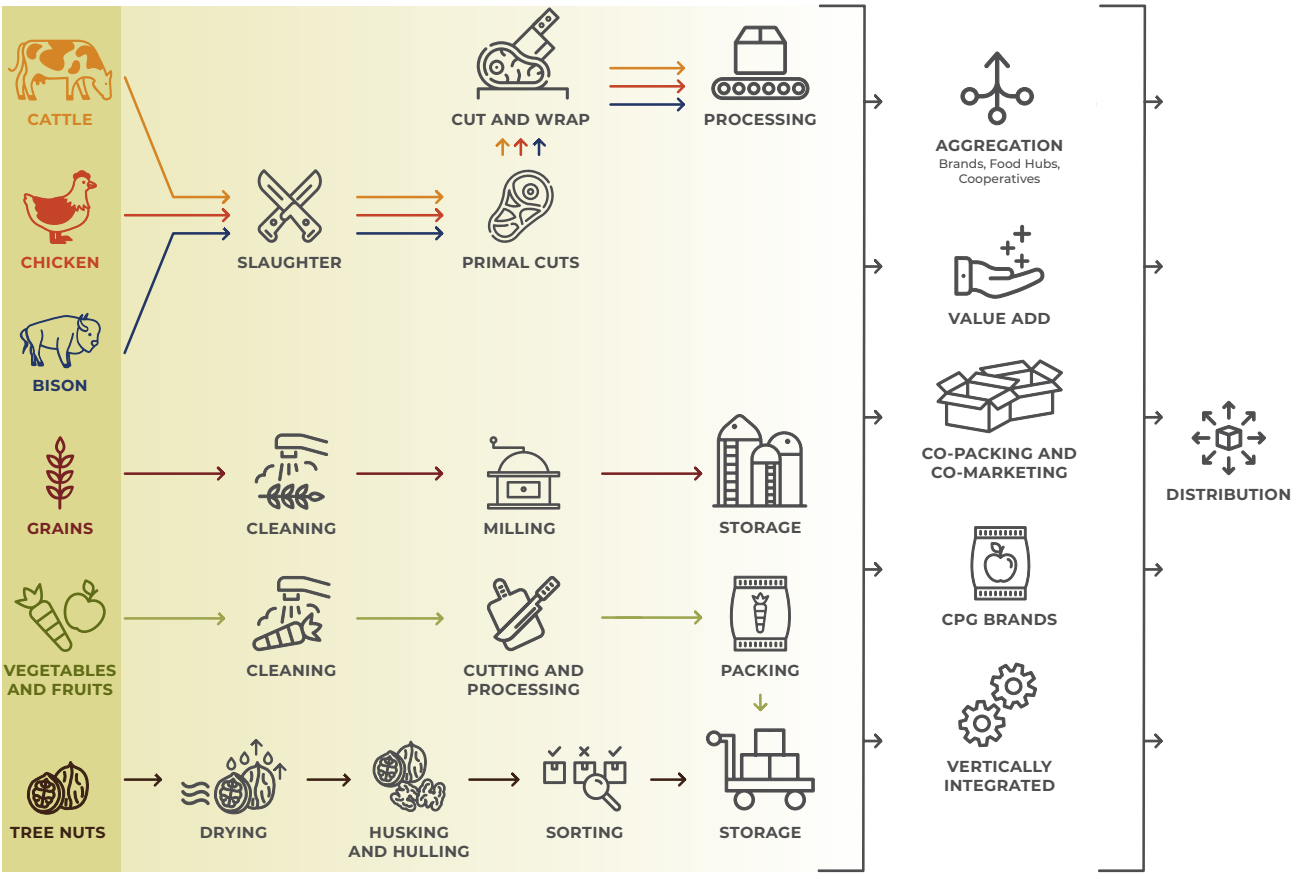
Even if conversion of natural lands in the Delta is largely avoided, there is a risk that switching to specialty crops in the Delta could bring higher energy consumption, waste, and greenhouse gas emissions in the region. Specialty crop farming is an intensive process and the processing that will be needed to support the entire supply chain can also come with a large environmental footprint.

To avoid this situation, sustainability should be a part of the crop selection process. Comparative analysis should be used to help determine what should be grown where. And, sustainability strategies should be embedded from the beginning throughout the production and processing chain. This will include investing in renewable energy sources, reducing reliance on fossil fuels, and lowering carbon emissions. Regenerative farming practices should be adopted, such as precision farming and integrated pest management, and a system should be put in place from the beginning to measure and reduce food loss and waste. To successfully integrate and implement these processes from the beginning, policy, research, and industry support will be needed.

[24]*DCF commodities are critical to a 1.5℃ pathway for commodity traders, Technical Methods and Summary (WWF, 2022)*

INNOVATIVE BUSINESS MODELS

The Next California isn't simply about bringing commercial-level specialty crops to the region but using them as generation for economic development targeted at wealth creation for farmers and communities, and specifically for minority farmers and minority communities. Historically, farmers receive a low, wholesale rate for their produce while additional value created throughout the supply chain vests to other participants. Farmers are left with the option to accept the situation or vertically integrate to own their own processing and infrastructure, an expensive investment out of reach for most farmers and a time-consuming business on its own. However, we have examined and imagined other models that can be used throughout the supply chain, from transitioning to specialty crops to on-farm improvements to value-added production and even plant breeding and genetic models. There is an opportunity to create a large-scale food system in the Mid-Mississippi Delta that changes the typical structure, changing who has ownership and equity and has the chance to build long-term generational wealth – and that type of integration and ownership of processing and value-added production is essential to ensure long-term farm ownership for smallholder farmers who otherwise will likely not be able to compete in the marketplace.



Equity Ownership and Funding Streams

There are multiple goals, formats, and benefits of community and/or farmer ownership models. First, there is an opportunity for ownership of all or part of a business, leading to direct economic gains as well as a chance for long-term wealth creation. This may also place control in the local community, which often leads to a more stakeholder-centric model. If infrastructure, processing, or other aspects of the food supply chain are locally owned and operated, they also bring jobs, tax revenue, and local buy-in and support for a project, which can often lead to additional government support. For The Next California, we have been especially interested in structures that allow farmers and communities to see increased value creation and economic opportunities by capturing a greater portion of the supply chain and therefore also more long-term security for smallholder farmers.

TABLE 5: COMMON LEGAL STRUCTURES FOR COMMUNITY OWNERSHIP IN THE UNITED STATES

MODEL	PURPOSE	OWNERSHIP	BENEFITS	EXAMPLE
Community Trust	A legal entity that manages and protects assets or resources for the benefit of a specific community.	Typically owned and governed by a board of trustees who act in the best interest of the community.	Clear framework for managing and distributing profits. Benefits community members unable to invest directly.	Berkshire Community Land Trust, Inc: Lessees gain equity in buildings and improvements during the lease but not in the land itself, which remains under BCLT ownership and control.
Co-op	An organization owned and operated by its members who work together to meet their shared needs and objectives. Profit goes back to the members who use the cooperative.	Members have equal ownership and decision-making power.	Owned collectively by members. Equal voting system. Already used in agricultural sector.	Central Alabama Electric Cooperative: Operates as a member-owned electric utility where its customers are also owners, represented by an elected Board of Trustees. Provides electricity to over 46,000 meters in central AL.
Partnership	A business structure where two or more individuals or entities come together to conduct a joint business venture.	Partners share the profits, losses, and responsibilities based on the terms of their partnership agreement.	Prioritizes profits for stakeholders. Harnesses innovation and efficiency of the private sector. Paid, full-time staff. Can bridge NGOs, government, and private sector.	University Park Community Solar LLC: Established in 2008 as a for-profit company. Thirty-five community members pooled an average of $4,000 each. UPCS has achieved a return of more than two-thirds of its initial investment so far.
Joint Venture	A business arrangement where two or more parties join resources to accomplish a specific goal or task.	Co-owned across multiple groups.	Can allow producers, workers, and buyers to all work together, disaggregating risk and sharing gains.	Central Nova Amafrutas, a fruit growing cooperative in Para, Brazil, is a joint venture between workers and farmers across more than 1,000 families

There are a handful of food businesses that provide examples of innovative structures and what is possible. Some are traditionally owned but used an unusual financing structure to access funds while retaining ownership. For example, Bhoomi is a sugarcane juice company with the goal of revolutionizing the sugarcane industry by supporting minority farmers. Located in Texas, Bhoomi was looking for early-stage capital but wanted to raise capital while staying connected to its mission and vision. The goal was to create wealth in the community and additional revenues for its partner farmers, but to do so, it had to accept initial investment to build out its processing facility. To accomplish these goals, it was funded through a reverse convertible note. Foodshed Investors, a group of angel investors, put together a highly unusual and innovative deal where they invested in return for equity, but structured that investment to allow buy-back with quarterly payments once the business was up and running. Functionally, this meant it operated as debt secured by equity, but the investment didn't appear as debt on the balance sheet so the business could still borrow for operating capital if needed. At any point, as long as it made sense for the company, the remaining amount owned on the equity buyback could be converted to debt at predetermined terms. It also meant that in the long-term, the business is ultimately owned by the original entrepreneur and/or other stakeholders, rather than an investor. There is more upfront risk for the investor, but with a chance to see financial returns while achieving social impact goals.

Other companies have received more traditional funding but make use of unique or innovative ownership structures to accomplish goals and support stakeholders. Organically Grown Company (OGC), pioneered efforts around the perpetual purposeful trust (PPT). OGC is an aggregator and distributor of organic produce, the second-largest independent organic distributor in the country. The original founders were deeply dedicated to a stakeholder model and tried a variety of structures, including a non-profit co-op, an agricultural marketing co-op, an S-Corp, and an ESOP, but ran into hurdles with all of them. Ultimately, they helped create a PPT. In this structure, the trust is the legal owner, and the business has a fiduciary duty to fulfill its designated purpose. In OGC's case, stakeholders manage the business with profits going to investors, employees, the local community, growers, and retailers. An elected trust protector committee monitors to ensure that all commitments are being met. It provides a long-term structure that will put stakeholders at its heart but does require slow-money investors since there are limited exit strategies. Investors see a return over a long period as earnings accumulate and ultimately the trust can buy someone out.

Other companies have copied OGC's example of an innovative structure but also used unique and creative financing mechanisms. Firebrand Artisan Breads has also chosen to use a PPT, but it had to approach it with a different funding structure since it was a start-up using a PPT rather than a well-established and funded enterprise. The company is an artisanal bakery founded with the purpose of employing those with barriers to employment, specifically people who were previously incarcerated or homeless. To ensure that this dedication would exist in the long-term and couldn't be changed with ownership, it structured as a PPT with 11 purposes in its corporate charter. However, Firebrand also needed to ensure it had the necessary start-up capital so it was funded through a 'stair-step flip.' In this model, investors receive 80-90% of the profits to start, but just until they recoup their original investment. It then steps down to 70% of profits for the investors to get to a 1.5-2x return. At that point, the ownership structure then 'flips' back so that the investors have a pro-rata share based on the cap table, perhaps 10-20%, and the business gets 80-90%. This method also allows businesses to ultimately own far more of their enterprise and enjoy long-term wealth creation.

There are also examples of creative approaches to vertical integration and farmer ownership. For example, Seal the Seasons is a North Carolina-based processor focused on selling flash-frozen

fruits, vegetables, and value-added products from those fruits and vegetables (e.g. smoothies) in local and regional markets. In order to develop regional markets, avoid having to vertically integrate with extensive capital investments in many locations, and support their partner farmers, Seal the Seasons uses a 'hub and spoke' model. In each region, it partners with one farmer who already has or is willing to partner with Seal the Seasons to invest in a flash-freezing facility. Seal the Seasons contracts to buy the frozen fruit and vegetables from that farmer, but to also pay that farmer, who is the hub, to freeze the fruits and vegetables from area farmers, who are the spokes. In this way, the hub farmer can see additional direct economic gains while the other area farmers can get access to nearby processing, sell at a higher rate than without that processing, and also have an outlet for "seconds" or slightly imperfect produce that would likely otherwise be left in the field and lead to food loss.

There are also several infrastructure and processing facilities making use of co-ops, or member-owned structures. For example, three nut processing/shelling facilities are owned and operated by farmer-cooperatives. Route 9 Cooperative and Chestnut Growers Inc are both chestnut processors, in Ohio and Michigan respectively. Missouri Northern Pecan Growers is a pecan processor in Missouri. All three allow farmers to vertically integrate and achieve economies of scale, with better access to markets and associated premiums. However, co-ops can also be difficult to set up and require a lot of work from members, so they may not be suitable in all situations.

Grass Roots Farmer Cooperative is also making use of a co-op model, but with an interesting funding twist. Grass Roots includes member farms in AR, MO, MS, OK, OR, and CA and is focused on processing regenerative beef, lamb, pork, and poultry. These farmers, all engaged in regenerative ranching and farming, wanted to vertically integrate to have control over their own processing facility, but were having trouble raising the necessary funds. As a long-term business without a clear exit strategy, debt made sense, but few banks wanted to loan the funds. Ultimately, RSF Social Finance stepped in and agreed to the unusual request of Grass Roots Farmer Cooperative – to use the meat itself as collateral for a loan. This unique approach took advantage of an asset the farmers already held and allowed them to secure the loan they needed, but it took an innovative lender willing to explore unusual collateral arrangements to accomplish social goals.

Examples of Innovative Funders

Foodshed Investors
Venture South
The Living Fund
Semillero Ventures
Solidarity Capital Group
Village Capital
RSF Social Finance
Equitable Food Oriented Development

TABLE 6: EXAMPLES OF INNOVATION FUNDING STRUCTURES AND STREAMS

TOOL	DESCRIPTION	RISK AND RETURN	PARTIES INVOLVED	CONTEXT OF USE
Perpetual Purpose Trust	A type of trust that is designed to exist indefinitely and is created for a specific purpose rather than for the benefit of specific individuals. The trust is managed by trustees who are responsible for ensuring that the trust's purpose is fulfilled.	Risk: is borne by managing trustees. Return comes in the form of positive social impact for beneficiaries as well as financial return.	Donor establishes trust and trustees manage trust.	Ideally, the company should have significant financial resources available to dedicate to the PPT. A company with a stable and established position in its industry is best suited. They should have a long-term commitment to their social goals.
Tax Increment Finance	Generates funding for infrastructure and economic development projects. It works by capturing the increase in property tax revenue that results from a new development or improvement project and uses that revenue to pay for the project.	Risk: Government or public sector entity issuing the TIF debt takes the primary risk, losing funds if the development projects do not generate profit. Return: Government benefits from increased tax revenues as the TIF district experiences economic growth.	Involves the local government or municipality, the property owner or developer, and the taxpayers.	Financing rural infrastructure projects and agricultural development. It allows local governments to fund projects without increasing taxes for all taxpayers.
Social Impact Bonds (Pay for Success Contracts)	Investors provide capital to fund social programs. The investors are repaid with interest if the program meets certain predetermined outcomes. They are designed to encourage innovation and efficiency in the delivery of social services.	Risk: Private investors bear the risk of achieving social outcomes and may not receive a return if the outcomes are not achieved. Return: Investors receive a return on investment if the predefined social outcomes are achieved.	Involves the government, private investors, service providers, and beneficiaries. The government initiates the program, investors fund it, and service providers deliver social interventions to the target population	Supporting agricultural programs that address social challenges in rural communities. Social Impact Bonds could fund initiatives with measurable outcomes like increased yields or healthier soil.
Revenue-share agreement (debt or equity based)		Risk: Investors bear the risk of company performance and revenue generation. Return: Investors receive a share of company revenues as interest or dividends based on the agreement.	Connects the business/ borrower receiving funding and the investors who gets a percentage of the business' revenue instead of traditional interest or equity.	Revenue-share agreements can provide farmers with access to funds for investing in their crops or operations, with repayments tied to their future revenue, which can be beneficial during uncertain agricultural market conditions.
SAFE (Simple Agreement for Future Equity)	Flexible agreements to provide future equity rights in exchange for funds without an immediate valuation. Conversion terms will typically be tied to specific events.	Risk: Investors risk the company's success and potential dilution of partnership – or loss of funds if business doesn't succeed. Return: Investors gain potential future equity ownership in the company.	Start-up raising funds from an investor(s).	Early-stage start-ups in need of quick funding without fixed repayment terms. It offers a simple and fast way to raise capital without the complexities of traditional equity financing.
Reverse Convertible Note	An investment that starts as equity but certain events trigger conversion of that investment to debt. At that time, investors receive payment to a set multiple of their principal investment and long-term ownership stays with the entrepreneur.	Risk: Investors risk losing their investment if the business doesn't meet with success. Return: Investors receive an agreed upon rate of return (usually multiple of principal) unless the underlying asset's value decreases significantly.	Includes an investor and a company or entrepreneur.	Investors seeking to achieve social goals through economic development may see this as a chance to earn rewards while seeding capital and ownership in a community. Agricultural companies with promising prospects could use reverse convertible notes to attract investors.

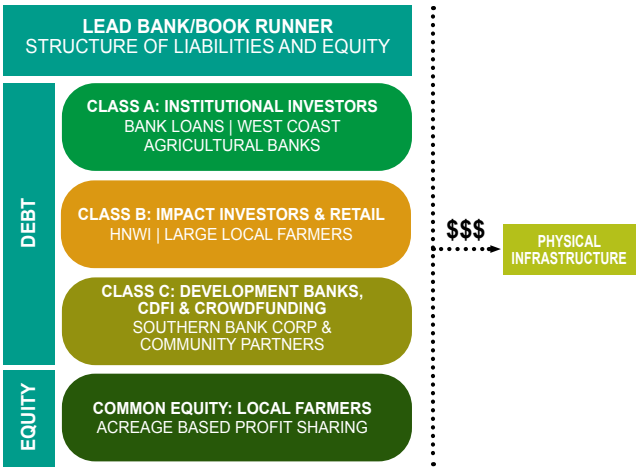
continued on next page

TABLE 6: EXAMPLES OF INNOVATION FUNDING STRUCTURES AND STREAMS | CONTINUED

TOOL	DESCRIPTION	RISK AND RETURN	PARTIES INVOLVED	CONTEXT OF USE
Long-Term Contracts	Agreements between agricultural producers and buyers that extend over a significant period, often spanning multiple growing seasons or years.	Risk: Both parties share risks based on successful partnership outcomes. Return: Both parties benefit from achieving the contract's objectives.	Consists of a buyer and seller entering into an extended business relationship for the supply of goods.	Securing stable supply chains and buyer agreements. Agricultural producers and processors can use long-term contracts to establish reliable relationships, ensuring steady demand and sales over an extended period. LTCs can serve as collateral for loans sought by the producer and de-risk investment in new business streams.
Whole-Crop Contracts	Agreements between agricultural producers and buyers to buy all edible crop, not just items meeting certain specifications.	Risk: Both parties share risks based on successful partnership outcomes. Return: Less food loss and waste with potentially more revenues from increased food sales.	Consists of a buyer and a seller entering into an agreement to purchase all produce, often leading to use of some produce in value-added products.	Securing stable supply chains and buyer agreements that limit food loss and encourage investment in value-added production.
Equity Crowd-funding	Individuals can invest in early-stage or growth-stage companies in exchange for equity or ownership in those companies. It allows individuals to become shareholders and potentially benefit from the company's success.	Risk: Investors risk losing their investment if the company performs poorly. Return: Investors receive financial returns if the company succeeds and their equity holdings appreciate.	Connects a small company seeking funding and investors contributing capital in exchange for equity stakes. Usually these investors make smaller payments	Enabling community support for local agriculture. Equity crowdfunding could allow small farms or sustainable agriculture projects to raise funds from their local community, fostering a sense of ownership and support.
Interest-Only Bridge Loan	A short-term loan where borrowers only make interest payments during the loan term. At the end of the loan term, the entire principal amount becomes due. This type of loan provides temporary financial relief and flexibility for borrowers, commonly used during transitional periods or to fund specific projects or investments.	Risk: Lenders face default risk if the borrower fails to repay interest. Return: Lenders receive interest payments during the loan term.	Risk: Lenders face default risk if the borrower fails to repay interest. Return: Lenders receive interest payments during the loan term. Involves a borrower and a lender.	Helping farmers bridge financial gaps between planting and harvesting seasons. Interest-only bridge loans can provide short-term working capital to cover expenses until crops are ready for market and revenue is generated.

While all of these examples could be used to help secure the goals of the Next California, there may be other ways to combine some of the efforts as well. For example, large-scale processing, which can be quite expensive, could be funded through a combination of debt and equity, with more traditional investors (institutional, impact, development banks, and CDFIs) investing through debt while farmers get a chance to earn equity. The debt investors would be needed to ensure enough upfront investment and operating capital. This could include local and regional banks in the Mid-Delta, agricultural financial institutions on the West Coast that are looking to diversify, impact investors, and CDFIs/community development banks. However, to ensure these projects are also equitable and built with roots in the community, farmers could earn equity over time, perhaps sharing in profits through an acreage-based model or through allocations based on use of the processing facility. There are a variety of ways of structuring this, but some of the community funds, CDFIs, and impact investors may be willing to accept slightly lower returns if the difference they accept in returns goes to farmers as equity. Farmers could also earn equity in place of some immediate profits, allowing them to build long-term ownership.

FIGURE 16: AN EXAMPLE OF A POTENTIAL CAPITAL STACK



Community and Social Bonds

Bonds offer an opportunity to raise large sums to accomplish social and/or environmental goals while making use of traditional investment structures. These bonds are still interest-bearing loans from investors, but can be tied into other social goals and used by non-profits, local governments, cooperatives, or charities. Through CDFIs (community development financial institutions) these bonds can also sometimes be secured by the federal government.

The Council of Development Finance Agencies (CDFA) uses three primary bond structures to finance food system development:

- **Industrial Development Bonds:** These have been widely used for small food manufacturers. They are authorized across all states and provide low-cost, tax-exempt financing for smaller and mid-sized food manufacturers.
- **501(c)(3) Bonds:** Finance agencies can issue bonds on behalf of certain non-profits for infrastructure that is related to their operation. For example, these can be used with hospitals, community centers, museums, and more. Some have been used for food-related operations including food pantries and community kitchens. They may also be relevant to communal cold storage or similar facilities.
- **Aggie Bonds:** About half of all states offer 'First Time Farmer Aggie Bonds' that provide tax-exempt financing to support investments in new and beginning farmers. These have been used for decades and are mostly targeted in agriculture-heavy states, including Arkansas and Missouri.

Community bonds have been used in a variety of relevant ways and programs, including for environmental projects, infrastructure projects, buildings, real estate, and businesses. These bonds have been used to promote social goals, raise funds to build impactful assets, and create long-term wealth through community or individual ownership. A few examples shed light on ways these types of bonds could be used in the next steps of this project.

Community bonds are increasingly being used in solar projects or other clean-energy infrastructure. Solarshare Bond II was incorporated in 2010 and has now grown to over 2,000 members. In aggregate, these members have invested nearly $80 million, earning over $12 million in interest. Solarshare develops community-financed solar energy projects and now has 18 solar power installations, with 600 kW of generation capacity. All of the projects include a 20-year power purchase agreement with the Ontario Power Authority, including fixed prices for power produced. This guarantees a long-term revenue stream for members. Similarly, Solarshare Wisconsin signed up five Class A contractor members and 80 investor members in its first year, raising around $460,000. This money funded the purchase of property for Solarshare Wisconsin's first two solar farms. They broke ground in 2023 and are projected to produce 4.5 MW of electricity. Members will receive financial returns that were previously limited to large-scale investors.

Community bonds can be used for projects beyond solar. The ZooShare Biogas Co-operative is a non-profit community co-op that is building a 500 kW biogas plant at the Toronto Zoo. Electricity will be generated by inedible food waste; that electricity will be sold to the grid and the fertilizer byproduct will be sold in garden centers. More than 800 members have invested over $7 million in the project. Like the solar projects, the range of investments varies and means even small-scale investors can invest and earn reliable returns through the projects.

Other bonds have been used for businesses, real estate, or with the explicit goal of establishing individual ownership of assets. Pillar Nonprofit was created out of a Community Volunteer Summit in 2001 and works to increase the accountability, credibility, visibility, and capacity of the non-profit sector. One of those efforts led to the creation, in 2016, of a co-working space for social innovators.

A community bond including 47 investors was used to finance the project. Investors received 3% interest for five years while also creating a community asset. Meanwhile, the West End Food Co-op runs a farmer's market in Toronto focused on serving food insecure communities. They used a community bond to purchase and renovate a new food store in a low-income neighborhood. Starting buy-in was at $500 with a 2.5% interest rate to try to be accessible to a large number of investors.

The City of Denver has taken community bonds in a different direction, using them to address long-standing home ownership inequality. It established the metroDPA Social Equity program to provide down payment assistance to increase homeownership in communities of color that were historically targeted by discriminatory practices, including but not limited to redlining. Residents and direct descendants of individuals who lived in a Denver neighborhood that was redlined between 1938 and 2000 can apply for downpayment assistance if they meet other metrics. These downpayments, offered at $15,000 or $25,000, are funded by a community bond. In this way, members can fund a social program that creates homeownership but also see a return on that investment.

Traverse City, MI also used a community bond for buildings, in this case to fund a mixed-use four-story building to bring more workforce housing to the city. The bond raised $1.37 million from 132 investors in a cooperative model. Members can earn returns, but also have community ownership and tenant ownership in the property.

Many of these same principles could be applied to community bonds for shared on-farm improvements, agricultural infrastructure, or programs around specialty crops in the Mid-Delta.

Seeds and Genetics

Plant genetics and seeds are a major business – and have a massive impact on what is grown where, in what conditions, and with what inputs. Historically, farmers used the seeds that were available to them naturally, saving seeds from the crops that grew best to use again next year. However, as farmers invested more time in procuring and improving upon the best seeds through natural selection, that began to change. "Over the course of the twentieth century, seed went from being viewed as a freely exchanged public good, toward increasingly considered a product of human invention that is owned and protected."[25] Today, plant breeding generally falls with a few groups: land grant universities, government/USDA, seed companies, freelance/independent plant breeders, farmers, and NGOs. Seed varietals and genetics developed can then be shared openly or protected through trade secrets, patents, or copyrights on brands.

However, the private sector increasingly dominates seed genetic research and ownership. For a variety of reasons, including that government grants are increasingly short-term and plant research is often long-term, there was a 21.4% drop in full-time employees in public (i.e. university) plant breeding programs from 2013-2018.[26] Instead, the seed industry is increasingly consolidated in a few, large, private companies. Today, "the top four seed corporations own 97% of canola, 95% of corn, 84% of soybean, 51% of wheat, and 74% of cotton intellectual property rights."[27] Most research efforts are focused on commodity crops and little is on improving the sustainability of crops. Seeds are also becoming more expensive. "Seed prices rose 700% over the last two decades for genetically modified (GM) seeds, and around 200% from non-GM seeds."[28] This prices out smaller farmers, meaning the hardiest and most robust seeds are usually inaccessible to those who would most benefit.

As specialty crops expand in the Mid-Delta, seed genetics will be important. The varietals best suited to grow in California are unlikely to be the ones best suited to grow in the mid-Delta. Having the hardiest seed varietals will mean fewer inputs, a boon for the environment and for farmers' finances, and, it is hoped, less food loss and waste. Unique varietals that are best suited to the Delta may also present a chance to revive heirloom varieties, build on culturally relevant crops, and develop a competitive advantage for specialty crops sourced from the region — even if it means showing something recognizable but a bit different to consumers.

However, to get there, more genetics research is needed and that research needs to be accessible to all Delta farmers – including small and minority farmers. This could be accomplished through more research at the region's land-grant HBCUs, or 1890s, including University of Arkansas Pine Bluff, Alcorn State University, and Tennessee State University. It could also be done through farmers in the region (see *Our First Pilot: Delta Harvest*) or through more unique approaches that focus on open-source models or cooperative farmer ownership models. There are a few entities exploring these opportunities.

The Open Source Seed Initiative (OSSI) is working to bring to seeds the same type of open-source collaboration as exists in the tech industry. It works with plant breeders and asks them to commit to the OSSI Pledge. This states: "You have the freedom to use these OSSI-Pledged seeds in any way you choose. In return, you pledge not to restrict others' use of these seeds or their derivatives by patents or other means, and to include this Pledge with any transfer of these seeds or their derivatives."[29] In exchange, the Open Source Seed Initiative does marketing and builds awareness of the importance of seed genetics and works to build support for and interest in purchasing food grown from OSSI-pledged seeds.

[29]*Open Source Seed Initiative. https://osseeds.org/about/*

The Ujamaa Cooperative Farming Alliance is dedicated to seed and genetic research and protection that provides support for historically oppressed and marginalized communities. It recruits and works with growers, assisting them in developing side businesses as seed farmers. This can increase revenue to farmers, while also letting them focus on culturally relevant seeds. The Ujamaa Cooperative Farming Alliance focuses on heirloom and native varieties, and also helps sell the seeds its farmers develop.

The Utopian Seed Project is taking a couple unique approaches to genetics. On a more direct level, it trials, tests, and breeds its own crops to find and develop varietals best suited to growing in the southeastern United States. This regional approach is one that would likely make sense to use in the Mid-Delta and elsewhere, ensuring that seeds that are being grown are well structured to local conditions and therefore best for the environment and farmer livelihood. All of the seeds it develops are open source and farmers can retain seeds from the crops they grow to plant again next year.

In a more radical approach, but one that points to important climate considerations moving forward, the Utopian Seed Project is also creating genetic collisions (i.e. encouraging genetically diverse plants to mix) in their fields to develop diverse mixes best structured to withstand increasingly chaotic climate events.

In 2021, Chris Smith, the founder, planted 100 different types of okra in one small field. Natural pollinators, such as bees, went to work cross-pollinating and Chris ended up with an “ultra-cross” of new seeds that he distributed to farmers. Fields planted with the ultra-cross yielded a vast array of types of okra. Not only can these mixes not be patented, since they cannot be described, inherently making them open source, but they also went through a ‘survival of the fittest’ process that produced the hardiest mix. The resulting plants can withstand a lot of extreme weather events, and the diversity across the field means that even if a certain type is susceptible to disease or weather conditions, it is usually possible to avoid catastrophic loss. There is a trade-off here between efficiency and biodiversity. In the short-term, it is likely that ultra-crossed crops are lower yielding than monocropping, but this may even out over time. If the monocrop is at much higher risk of total loss while the ultra-cross rarely sees high-level failure, effective yield over three, five, or 10 years might lead to better results and lower waste — a prospect worthy of further study. Labor needs, though, may be harder to tackle. If crops are ripening at different times or resulting in fruits or vegetables of different sizes and shapes, it may be much harder to automate harvesting. Since labor is the single largest expense usually cited by farmers, this could be a significant hurdle. However, it may be possible to find a happy medium. Chris is now experimenting to see if he can keep the idea of an ultra-cross but control for harvest time or harvest type of crops. He’s also trying to encourage other regions to engage in similar work. All of these examples could provide important examples and learnings for the Mid-Delta.

OKRA DIVERSITY FROM AN ULTRA-CROSS

CHRIS SMITH AND ULTRACROSS PLANTINGS

MARKETS

Buyers of produce, including retailers, food service organizations, and food companies, are increasingly focused on security of supply. Over the last few years, they have seen markets disrupted due to COVID-19, weather events, war, and shipping woes. Since many of them source heavily from California, they are concerned about what this will mean with changing climate conditions and worried about largely sourcing from one region with increasingly erratic weather events. Without market interest and buyer investment and commitments, it will be all but impossible to meet the full goals of The Next California. Supply chain and other concerns mean that markets are more open to having these conversations than in the past, but it still requires a change in behavior to get involved this early — so finding the right partner to share in disaggregated risk is pivotal.

Buyers

Through in-depth discussions with the VP Produce or similar executives at a couple dozen major retailers, restaurants, and food companies, it has immediately become clear that buyers are eager to explore new markets and learn more. The risk to California's production is top of mind, but food safety and consistent supply at affordable rates also remains paramount. Every company we spoke to sources heavily from California, but with some variance. Many source nearly all of their vegetables and other specialty crops from the state, but fruits are increasingly sourced worldwide as buyers 'chase' consistent quality and supply, and investment in sourcing locally varies widely. Nearly every company acknowledges that customers like to see local food, so they do their best, but the percentage purchased locally varies across the stores, from nearly nothing to a high of about 20%. Local is sometimes defined as in-state, sometimes in-region, and sometimes by coast.

When making sourcing decisions, food safety is always paramount. There was unanimity on this topic. If these standards can be met, quality and consistency were always cited as the next concerns. Buyers need to know they can depend on a grower or region on both of these topics; inconsistency is increasingly keeping buyers up at night. Buyers cited examples of cherry seasons that started late and ended early, catastrophic loss in blueberry-growing regions, constant struggles around lettuce, and more. In short, every buyer has struggled to buy something from traditional sources and is concerned that these issues will only increase in the future. Cost is and will remain a concern, but it's typically not the driving force for a number of major companies struggling with these other concerns. For smaller companies, however, which typically are forced to follow the consumer prices offered by larger companies, cost can be a more dominant factor.

Historically, buyers would source from a region once there was consistency in production there, but they have exhibited increasing willingness to get involved earlier to build long-lasting supply, such as in The Next California. This would be a change in behavior for most buyers, though, so what that would look like is still open to discussion. Buyers want a chance to build something that supports their own needs but may be willing to take on shared risk to help bring that to fruition.

Buyers are especially interested if a new region could help to meet key needs, such as filling gaps, decreasing costs for certain crops, or offering something unique. Lettuce is at the top of a lot of 'wish lists.' There is a lot of interest in filling in the gaps created by the current sourcing switch between California's Central Valley and Yuma, AZ. During shoulder seasons, lettuce supply can be tenuous. There is also interest in additional growing locations due to many food safety incidents and the security of diversity of supply. Heavy vegetables are also at the top of request lists. For example, one buyer explained that celery is such a heavy crop that trucks cannot

be filled to capacity, increasing environmental and financial burdens. If heavy crops were able to be purchased closer to high-population East Coast cities, buyers would benefit.

There is also increased interest and flexibility in more unique varietals. For example, one buyer explained that he is more interested in sourcing buttercup squash than butternut squash. Buttercup is similar enough to the more popular butternut squash that consumers know how to use it and will buy it, but also different enough to provide a unique experience. When there are slight differences like this, there is also increased flexibility on price. There is particular interest in culturally relevant varietals and native varietals, with the caveat that they still need to be accessible to consumers.

Knowing that there is increased risk here, buyers are more willing to engage in long-term contracts (LTCs). Typically, buyers use one-year contracts (or no contracts) but many of them are already exploring LTCs or expressing a willingness to have those conversations. This could help to disaggregate risk between buyers and growers. There is less expressed interest in paying for ecosystem services or environmental benefits. Other than a couple brands that have built value around sustainability, companies are not currently paying for environmental benefits nor embedding those in contracts. They can, though, be a value-add and a differentiator in choosing between growers. Many, but not all, of these companies are also now making or exploring environmental commitments, but they range in focus and breadth. They include Scope 3 emissions, carbon sequestration, soil health, supplier diversity, water, biodiversity, farmer livelihood, fair labor, and packaging. Being able to tie purchases into existing commitments is always a value-add.

As retailers, restaurant chains, and food groups look at sourcing, minimums can also come into play. Many larger chains (e.g. Walmart, Kroger, etc.) may have higher minimums, with the need for each grower to service a certain number of stores or distribution centers. While these larger players may be better positioned to disaggregate risk, they may not always make sense as a first buyer if the quantities aren't large enough. Family chains and mid-size companies (e.g. Schnucks, Wegmans, etc.) may be better placed to be first movers. It will be a bigger risk for these stores but they may have greater flexibility in working with growers as they develop. Smaller, local chains, meanwhile, may be the most invested in the local community but also the least able to take on additional risk.

There may be a role for buyer groups or associations, such as the International Fresh Produce Association (IFPA), to assist with next steps and early adoption. IFPA has been extremely supportive of this work, which ties into its own goals around increasing supplier diversity and boosting availability of fresh fruits and vegetables to more communities and, in turn, more consumers. IFPA has introduced The Next California at some of its own events and is collaborating on a related initiative in the Delta over the next five years to assist regional producers in accessing new markets. IFPA may be able to help pool and share data so that farmers can grow crops most likely to see significant market demand. It can also help the industry explore sourcing from new regions at a high level. Many buyers aren't used to judging produce from the Delta, and there is a lack of historical data on yield, varietals, and risk. IFPA may also be able to support advocacy and programmatic efforts to continue to de-risk efforts for Mid-Delta growers, supporting long-term supply-chain security and resiliency.

Aggregation and Infrastructure

While many buyers buy directly from growers, aggregators can be essential in helping small farmers to reach markets. They also often provide invaluable technical assistance. They can be equally beneficial to buyers, with aggregators allowing them to contract with a single entity and providing a check on food safety. There are a few models that may provide partners in next steps and/or provide important lessons learned.

The Common Market is a nonprofit food hub focusing on building a regional food system in a sustainable manner that supports farmer livelihood. Founded in

2008, The Common Market has worked with over 300 sustainable family farms and more than 1,800 partner institutions. It provides technical assistance and support to small farms, physically aggregates products in its warehouses, and then sells to institutions such as K-12 schools, colleges and universities, healthcare institutions, food-as-medicine providers, and more. The Common Market has warehouses/hubs in the Mid-Atlantic (Philadelphia, PA), the Southeast (Atlanta, GA), Texas (Houston), and the Great Lakes (Chicago, IL). Its model eases the burden on farmers, helping them build sustainability practices, engage in food safety and GAP (Good Agricultural Practices) certification, and reach markets. It helps markets source regionally from small, sustainable farms by simplifying the process. The Common Market is currently mostly focused on urban markets with products sourced from local foodsheds, but its physical aggregation model can provide important learnings.

Cureate is a mission-driven food-tech company approaching aggregation through a technical-assistance and virtual-platform model rather than physical aggregation. Cureate offers a food business program, Cureate Courses, to farmers and other food and beverage entrepreneurs and serves as a matchmaker between supply and demand through their proprietary procurement platform, Cureate Connect. It works with institutions to source from growers, taking the burden off buyers by handling all logistics, payments, and vendor onboarding, as The Common Market does, but it doesn't physically aggregate and deliver; instead, the team works with farmers and food entrepreneurs to get access to markets without this step, therefore allowing farmers and entrepreneurs to retain a higher margin. Cureate is headquartered in Washington, DC with operations in the Mid-Atlantic and the Heartland regions, servicing Maryland, Washington DC, Virginia, and Arkansas.

In addition to aggregation, there will need to be significant investment in infrastructure to bring specialty crops to scale in the Mid-Delta. Harvesting commodity row crops such as wheat, rice, cotton, corn, and soy for animal feed is a largely mechanized and straightforward process. Large equipment, such as combines, is used to harvest the crops. They can move quickly and at scale, with a single farmer able to cover a couple thousand acres. There is no cold storage and no additional value-added processing. Typically, these crops are dropped off in bulk to local buyers.

Specialty crops require a far more complicated supply chain. While automation and robotics are improving (see *Action Items and Next Steps*), these crops are largely still harvested by hand. The exact supply chain will vary across different crops, but there is usually some level of sorting/grading, washing, and packaging. The majority of the crops also require cold storage. Some crops go for additional value-added processing such as flash-freezing, shelling, canning, pureeing, or other actions.

There is very little infrastructure in the Mid-Delta to support these steps, but if the food needs to be shipped far outside of the region, the Delta will miss out on the economic gains that come from these steps. Farmers have a chance to earn additional equity and wealth if they are connected to this supply chain and value-added production creates more desirable, stable jobs in the region.

This lack of infrastructure is already creating hurdles. For example, there is a lack of cold storage across the region. This is one of the most essential steps in the supply chain process for fresh produce; its absence limits the ability for farmers to access markets. One farmer, who is GAP-certified and grows fruits and vegetables around Stanton, TN, largely sells directly to consumers through farmers markets. But he is interested in selling to commercial customers as well. He did explore that opportunity once, working to sell to FreshPoint, a produce wholesaler located in Nashville, TN. Unfortunately, that meant a 2.5-hour drive each way without the necessary large-scale truck required for docking. By the time loading and unloading by hand on each end was added to the transportation time, it no longer made financial sense to sell to FreshPoint. Ideally, he would love to see cold storage and a food hub in Memphis, which is much closer but currently lacks such a feature, or throughout the Delta with an option for farmers to own or earn equity in the distribution process.

FIGURE 17: AN OVERVIEW OF STEPS IN THE SUPPLY CHAIN WHEN HARVESTING SPECIALTY PRODUCE

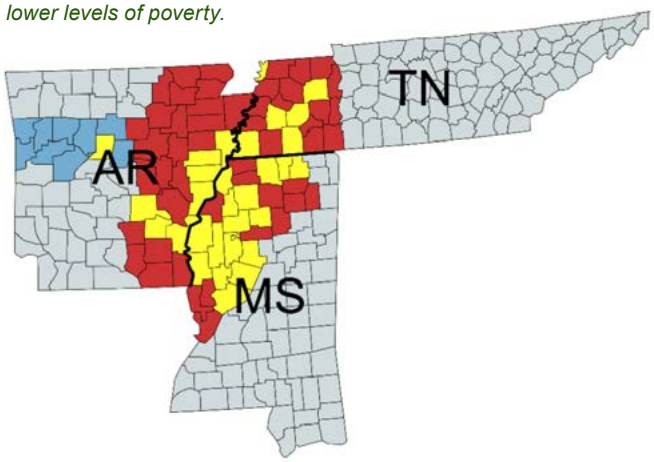
There are some efforts to bring more cold storage to the region. Ritter Farm, one large farm in eastern Arkansas that has entered the specialty crop world in the last few years, diversifying from row crops, has invested in its own cold storage. Its facility has excess capacity outside the harvest seasons of the farm's two primary specialty crops. The farm says it is happy to share and lease space to other farmers to help them access infrastructure while also providing an additional source of revenue from an underused asset.

Warehouses4Good, meanwhile, is a nonprofit that works to build technology-advanced cold storage warehouses in rural communities to connect farmers to markets and address food insecurity. It designs and builds the structures but works with local partners and hands over ownership after the facilities are complete. While this has historically been done in partnership with food pantries, the nonprofit is eager to pursue ownership transfer to farmers and is currently looking at sites in the Mid-Delta. There are also numerous ways to capitalize on the lack of infrastructure, a hurdle, and turn it into an opportunity by building it in a more equitable and sustainable way (see I*nnovative Business Models*).

It is also essential to consider where that infrastructure is built. We took the entire Mid-Delta region defined in Phase I of The Next California and narrowed it by focusing on counties that include Black growers, and eliminating counties that are above the national and state poverty rate. The yellow counties below represent the "target" counties that include a diverse mix of farmers and the need for economic development and wealth creation. As investments are made in infrastructure in the region and resources are built, it is imperative to ensure they are in or close to these targeted counties so that The Next California is set up to be equitable and reach farmers and communities that can most benefit from this shift.

FIGURE 18: WWF'S TARGET REGION, WITH THE MID-DELTA REPRESENTED IN RED AND THE ARKANSAS RIVER VALLEY IN BLUE

Yellow counties demonstrate target counties for infrastructure investment, identified through presence of Black farmers and lower levels of poverty.



Environmental Benefits and Ecosystem Services

In recent years, the food sector has recognized both the liability and opportunities that its environmental footprint creates. Both corporations and countries have set targets for reducing their climate emissions associated with food, and new frameworks for land, water, and biodiversity are in development. The strategies for meeting these goals range from producing current crops in a more sustainable or even regenerative way to shifting what food products are grown and consumed. Both market-based approaches (i.e. carbon or ecosystem service credits) and supply-chain or regional incentives have been proposed and promulgated. However, the focus of these interventions and the guidance for how to navigate the many standards and options have typically been on the staple crops (e.g. wheat, soy, etc.) and livestock. In Appendix E: Environmental Impacts and Benefits of Specialty Crops, we provide high-level information on the importance of addressing the environmental impacts of specialty crops; the accounting frameworks typically used for agriculture and how they apply to specialty crops; and a brief overview of some of the tools that can be used in assessing and monitoring farm or buyer-level impacts from specialty crop production.

ACTION ITEMS AND NEXT STEPS

Phase II of The Next California has been about moving from research to action. The goal was to answer all the additional questions and bring together the needed stakeholders to move into next steps, pilots, and action on the ground – filling in the 'how' part to get us ready to implement. However, as the ideas have been seeded and as work has progressed, individual efforts have already started moving forward. WWF strives to serve as a catalyst, and those efforts are already yielding some results. There have been numerous forward steps by partners and affiliated groups, a chance to highlight and support existing efforts that were already taking place, and now the launch of The Next California's first pilot.

Forward Steps and Spin-Offs by Partners

Phase I introduced the big idea of The Next California to the region and began to build stakeholder support and bring together partners. Since that report was released in February 2020 and throughout Phase II efforts, many partners and affiliated organizations have moved forward with next steps, setting the stage for Next California, boosting efforts towards the larger goal across the region, and jumping into bringing the idea to fruition.

AgLaunch, a key partner from the beginning of the project, is a non-profit focused on farm-centric innovation and technologies. It connects entrepreneurs with growers and incubates and accelerates ag technologies, but with farmers earning equity rather than AgLaunch itself. It specifically works to build more sustainable farms and works with a diverse group of farmers. However, it has historically worked with commodity row crops since those have dominated the region. After supporting Phase I work, AgLaunch applied for and received Economic Development Association (EDA) funding to launch the AgLaunch Robotics Consortium. This arm of AgLaunch brings together farmers, robotics companies, investors, universities, and economic development organizations to address labor issues with specialty crops through robotics. The effort kicked off with a two-day event and then moved into the next phase, AgLaunch365, an accelerator and field trial program similar to the work AgLaunch has been doing with row crops and livestock. AgLaunch365 just held its most recent demo day in February 2024.

While AgLaunch is focusing on its expertise, farmer support and ag technology, other groups are using conferences to engage across the region. Crusonia on the Delta (previously Davos on the Delta) dedicated its 2020 conference (originally planned for Memphis but then held remotely) to The Next California, focusing on what it might look like and the need for it to exist.

Meanwhile, the Arkansas Department of Agriculture used the Phase I Next California report as a guide and springboard to apply for and receive a USDA Specialty Crop Block Grant in 2022 to identify specialty crop farmers in Arkansas who were interested in scaling up to wholesale, meet with them to determine needs, and develop infrastructure connecting support organizations to farmers to overcome gaps. The department cites The Next California as a major influence in its decision to pursue this project. The work culminated in the first-ever Arkansas Grown conference in January 2023, where Julia Kurnik delivered a keynote, speaking about The Next California. The conference was projected to draw around 100 people but sold out at 450 attendees. Due to its success and the strong interest in bringing more specialty crops to the region, the second Arkansas Grown conference was held in January 2024 with an expanded audience and a Next California track so attendees could learn more.

Multiple university partners are also investing more deeply in specialty crops due to their involvement in the project. The University of Arkansas has added crop mapping and predictive analysis into its curriculum and research plan for the next few years, specifically looking at fruits and vegetables. Trey Malone and Courtney Cooper, who completed research for this report (see *Commercial-Level Production Research*)

are continuing their work and pursuing peer-reviewed publications and further research. They also hosted the first Agri-Food Innovation Summit in November 2023. This summit brought together USDA funding program managers (the largest such group ever to come together in the state) along with outside funders, entrepreneurs, and researchers. The Summit drew over 200 people, far exceeding expectations; Professor Trey Malone shared that University of Arkansas had never done something like this before and said it wouldn't have happened without The Next California project.

At the University of Memphis, a masters (and now PhD) student dedicated her thesis to exploring infrastructure needs for establishing a commercial-sized specialty crop industry in the Mid-Delta. This led to widespread department support. The University of Memphis is now exploring the creation of its own food center tackling many of the issues identified by The Next California and the burgeoning work of its students.

Finally, new USDA programs are being used to seed efforts and offshoots. The Resilient Food Systems Infrastructure (RFSI) grants are currently rolling out to each state. Several Council members and various other partners are applying for RFSI grants in Delta states to implement or launch pilot Next California projects. Meanwhile, the Regional Food Business Centers Program is creating 12 new centers across the country, including one in the Delta. While the Delta center is independent of any work being done by The Next California, the team running the Delta RFBC has asked several Council members for support, guidance, and strategic involvement.

Existing Examples

In addition to direct offshoots, there are projects underway across the Delta that highlight what is possible. As we move into Phase III, there will be a focus on supporting current efforts and scaling wherever possible to build upon early successes and entrepreneurial wins.

The Natural Soybean and Grain Alliance (NSGA) is an agricultural non-profit organization based in Arkansas that develops and conducts economic and agronomic projects throughout the state and wider region. The co-founders of the organization were at the point for establishment of the edamame soybean industry in Arkansas, which is now recognized as the largest of its kind in the US. The industry has been instrumental in providing up to 40 full-time jobs in the small community where it's located and excellent economic options for both established and new farmers through a large sector of the state. Development of the edamame industry has served as a baseline model in large part through providing an easier transition for farmers using very similar cropping systems. This model has served as an excellent example for specialty emerging agricultural industries and provides a case work of cooperative efforts between public and private entities to bring high level and unique industries to a successful conclusion.

Delta Dirt Distillery is a family and farmer owned craft distillery making sweet potato vodka, among other spirits, from produce and grains grown on their own farm. The Williams family, the owners and farmers, have been farming in Phillips County, Arkansas for five generations. The original patriarch, "Papa" Joe Williams, sharecropped the original 86 acres starting in the late 1800s. His son, UD Williams, took over and was eventually able to purchase the land in 1949, using money from sharecropping cotton and making homemade moonshine. This represented an extremely rare achievement for a Black sharecropper. Harvey Williams Sr. inherited the land but it became increasingly difficult to make ends meet with commodity row crops. He switched the farm to vegetable production with a focus on sweet potatoes. Today, Harvey Williams Jr. and his brother, Kennard Williams, are farming the land. In their quest to continue to create additional value, they began Delta Dirt Distillery in 2017 to create craft spirits from their produce. Harvey Jr. worked with his wife, Donna, and their son, Thomas, to create Sweet Blend Vodka from distilled sweet potatoes and corn grown on their farm, releasing their first bottles in 2020. Today, their

other son, Donavan, has joined the business as well. There is a state-of-the-art distillery in Helena, AR, and in addition to their vodka, Delta Dirt Distillery is producing Tall Cotton Gin and Arkansas Brown, a unique take on bourbon. Their products are offered across Arkansas, Mississippi, Texas, Tennessee, and parts of Pennsylvania as well as online.

Delta Peanut is a 100% farmer-owned processing and shelling facility located in Jonesboro, AR. Seventy-three farmers who were interested in switching to higher value crops but wanted to find a way to share risk came together across the Delta (Arkansas, Southeast Missouri, and Northeast Louisiana) to vertically integrate and build a peanut processing facility. With this scaled coalition, Delta Peanut was able to work with companies on long-term purchase agreements and guarantees. Today, Delta Peanut is selling at scale to large food companies, and farmers are seeing gains from their vertical integration and equity ownership of a processing facility.

There are also individual farmers already transitioning into specialty crops. Ritter Farms, one of the biggest farms in AR, has been an early supporter of the project and has been consistently expanding into fruit and floral production as a way to diversify away from commodity row crops. It is also exploring other specialty crops. Meanwhile, Healthy Flavors, a row crop legacy farm, began to switch and rebuild its model around specialty crops after hearing about the project and engaging in conversations to learn more. There have been numerous other farmers who have reached out to learn more and explore possibilities.

Delta Harvest: Next California's First Pilot

In January 2024, Hallie Shoffner, a Next California Advisory Council member and a sixth-generation Arkansas farmer, launched Delta Harvest as the first pilot of The Next California. Delta Harvest is a scientific and social enterprise with the mission to develop and promote high-quality US-grown specialty rice products. It is specifically working with Black and women farmers across the Delta to build a more nutritious, farmer-strong, consumer-centric, and climate-friendly rice industry. It will be building on, testing, and demonstrating The Next California goals with an easier-to-transition crop that can bring increased profits to farmers and more nutritious and environmentally friendly rice to consumers.

There is a significant market for specialty rice in the US – and those gains could go directly to Delta farmers. In the US, rice is a $6.8 billion industry, with specialty rice making up a quarter of the market. However, just 10% of specialty rice consumed in the country is grown in the country and that production is concentrated in the Sacramento Valley region of California. Specialty rice isn't a robust segment of the rice industry in the Delta, due to a lack of processing, brand development, genetics, and technical assistance.

Delta Harvest will address these hurdles by investing in R&D to improve varieties and create seed stock. Hallie Shoffner is a sixth-generation farmer and specialty rice producer. She has the expertise and strategic partnerships to promote and produce more acres of specialty rice in the Mid-South while developing improved varietals for yield and environmental sustainability. Delta Harvest will sell seed stock to farmers and build a pipeline of supply through technical assistance, but also provide access to storage, processing, and market contracts. Buyers will be able to work with Delta Harvest, building on similar aggregation models, rather than having to find and source from many individual small farmers – a significant barrier for many buyers. Delta Harvest has the goal of increasing specialty rice acres in the Delta– grown largely by Black and women farmers.

Delta Harvest's efforts directly build off The Next California work. The Next California's vision and shared goal is to create an audacious and radically different specialty-crop industry in the Delta that is grown sustainably, generates wealth creation and prosperity, and builds equitable ownership. Delta Harvest is piloting all of those efforts through a focus on specialty rice. Delta Harvest's first four farmers are all Black and/or women farmers in the Mid-Delta,

and Delta Harvest is exploring an offshoot 501(c)5 to provide technical assistance and explore innovative ownership structures and brand possibilities. The company is also creating wealth in the region through partnerships with rice processors. Delta Harvest has just secured its first buyer contract and product will be available in 2025.

Finally, Delta Harvest is committed to sharing its lessons learned. If successful with specialty rice, Delta Harvest is interested in exploring other crops but also in transparently sharing its work, successes, and failures with others as new pilots and offshoots launch.

Phase III Next Steps

The Advisory Council will now shift from an advisory role to an implementation role (see *Overview of Phase II Process*) and has put together a list of key activities to accomplish. Phase III kicked off March 1, 2024, and will extend for at least another year. In addition to the reinforcing activities that individual organizations committed to as part of their Council participation (see *Overview of Phase II Process*), there will be joint activities that the Council will undertake together. While this will continue to evolve and change based upon needs, there are several that have already been defined:

- Support and launch pilot projects, such as Delta Harvest. Focus on farmers least likely to have market access, scale up existing efforts in addition to launching new ones, and help connect farmer entrepreneurs to processing and market premiums.
- Put together a "travel panel" of farmers and have them share their stories in connection to this effort with buyers, at conferences, and at other targeted events and sites to develop further partnerships and support.
- Host a forum of key stakeholders with the goal of connecting existing crops and efforts with buyers to build relationships and wealth and to get more seeds in the ground now.
- Explore work with Oak Ridge National Laboratory to design, model, and ultimately bring to life a series of farm system models demonstrating innovative practices across the entire supply chain to meet environmental goals while creating economic prosperity.
- Complete mapping and analysis of existing resources and map out needs to reach the full potential of this project.
- Examine the data gap that creates a barrier for farmers to access loans and insurance. Explore whether the Council or AgLaunch's new crop-selection framework can help to capture and fill this gap to provide information and disaggregate risk to better connect farmers to finance and insurance.

In addition to the above actions, the Council intends to explore the potential of branding and a new name as it moves into implementation. To date the impetus for the project has been considering where "The Next California" will be, as California is forced to make difficult decisions over how to use its natural resources and some farming will need to shift out of the state. But it is now also about building something new in the Delta – an equitable and sustainable farming system that serves as an engine of economic development. Stakeholders want to ensure that there is a new name that reflects this focus. The project isn't about taking something away from California, but about creating something new in the Mid-Delta. The Council has begun efforts to examine new names and branding, so The Next California project can lead to actions and on-the-ground pilots under a new name. This will also provide a chance to consider audiences and branding to see if there is room to create additional value through telling a story. All of this will continue to be probed throughout Phase III.

CONCLUSION

The Next California remains a risky project. Significant hurdles remain, and extensive investment and coordination will be needed. It is also possible that unintended consequences will arise that disrupt the goals of the project or create new risks that are harder to surmount. Ultimately, despite early progress and momentum and stakeholder buy-in and support, The Next California could still fall short of its audacious goals.

However, The Next California has effectively set the stage for a radically new farming system in the Delta that supports farmers, boosts communities, creates new assets, increases wealth creation and job opportunities, brings healthy food to the region and beyond, and diversifies and revitalizes the region. The Delta has the opportunity to showcase how transitioning crops thoughtfully can avoid environmental degradation and harmful practices while boosting an economy in a just and equitable way. The US isn't alone in facing food supply-chain challenges. Countries and regions across the globe either are or soon will be facing similar questions, but few are thinking proactively about where and how food production should shift. The Delta has an opportunity to not only invest in itself, but also to serve as an example of what farming can and should be and how to get there. These lessons will reverberate far outside of the region and, it is hoped, demonstrate what a more equitable and sustainable farming system should look like everywhere.

APPENDIX A: ADVISORY COUNCIL MEMBERS

Lanny Ashlock
Chairman, *The Natural Soybean and Grain Alliance*

Cindy Ayers Elliott
MS Farmer, *Footprint Farms*

Sunny Baker
Senior Director of Programs and Policy,
National Farm to School Network

Torrey Bates
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Graduate Assistant, *University of Memphis*

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Center for Mississippi Food Systems

Kelly Cartwright
Director, *The Natural Soybean and Grain Alliance*

Marcus Coleman
Agriculture and Food Systems Educator,
Tulane University

Kevin Coogan
Vice President, *Community and Economic Development, Hope Enterprise Corporation*

Courtney Cooper
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SVP, Community and Economic Development,
Hope Enterprise Corporation

Cory Henry
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Haile Johnston
Chief Development Officer, *The Common Market*

Brandon Lawshe
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Ritter Agribusiness

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CEO, *Quantified Ventures**

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Emily Moberg
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President and Executive Director, *AgLaunch*

Phillip Owens,
Research Leader, *University of Arkansas*

Shawn Peebles
AR Farmer, *Peebles Organic*

Matthew Robinson
TN Farmer, *The Produce Tribe*

Hallie Shoffner
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National Center for Appropriate Technology and Mississippi Food Justice Collaborative

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Darnella Winston
MS Farmer, Director,
Mississippi Association of Cooperatives

Ryan Yates
Principal Scientist, National Center for Natural Products Research, *University of Mississippi*

Anthony Young
President, *Southern Bancorp Community Partners**

Matt Weathersby
Cushman Wakefield

Leah Windsor
Associate Professor, Applied Linguistics,
University of Memphis

**has switched positions since participating in the Council*

APPENDIX B: THE NEXT CALIFORNIA PROJECT: PHASE II - COMMERCIAL LEVEL PRODUCTION OF SPECIALTY CROPS

This appendix was written by Dr. Trey Malone, Agricultural and Food Economist, Department of Agricultural Economics and Agribusiness, University of Arkansas Division of Agriculture and Courtney F. Cooper, Doctoral Student in Environmental Dynamics, Department of Agricultural Economics and Agribusiness, University of Arkansas-Fayetteville

Table of Contents

Part I: Crops and Varietals Most Suitable to the Growing Region in the Mid-Delta Today and Those that are Projected to be the Most Suitable by 2050

Despite the differences in production ecology, some crops might transition from California to the Mississippi Delta. We examined budgets developed by the Cooperative Extension Service at the University of California – Davis[30] and Mississippi State University Extension[31] to explore this possibility. We focus on net returns above total costs and water-to-operating costs. Our rationale is two-fold. A crop's total costs include operating costs (pesticides, fertilizers, irrigation, labor for harvest, etc.) and overhead costs (land rent, insurance, field sanitation, tunnel structures, trellis systems, etc.).

We start with water-to-operating costs, as crops with high water-to-operating costs are likely to be the first to need a new home if California's drought and regulatory burdens force agricultural production systems to shift. That said, just because the crop might leave California does not mean it would pose an opportunity for profit in the Delta. Agricultural producers generally operate on razor-thin margins with little room for high-risk options. Some crops may have very low operating costs completely covered by expected revenue. However, the initial overhead costs of installing infrastructure may take several years to pay off completely. If revenue after total costs was calculated in both the first year and the following years after establishing a crop, the revenue for 3-4 years after establishing was used. The ratio of water to operating costs was the percentage of operating costs that water accounted for.

FIGURE 1B: RATIO OF WATER TO OPERATING COST

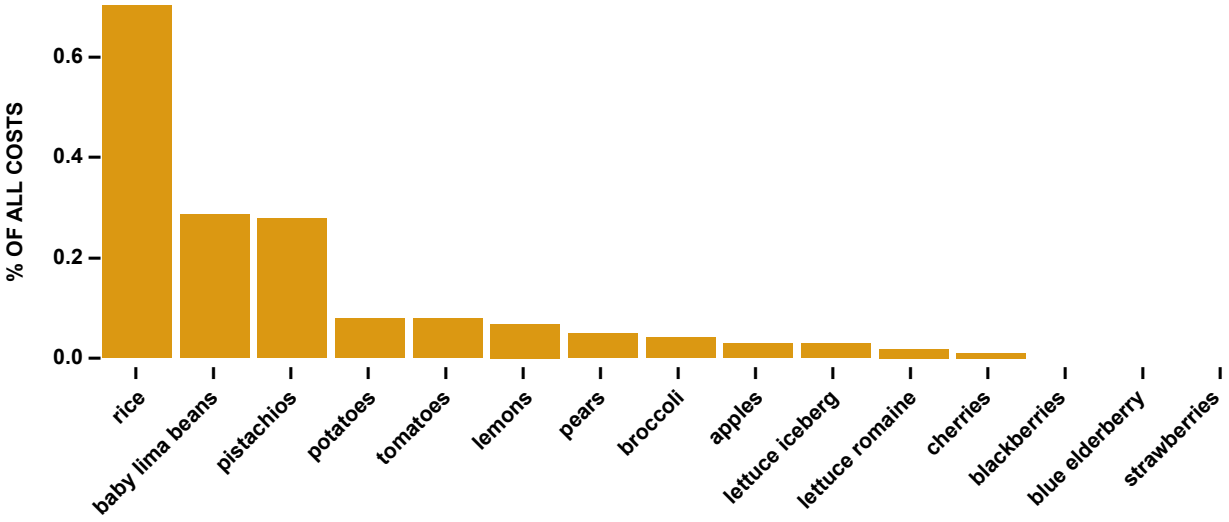
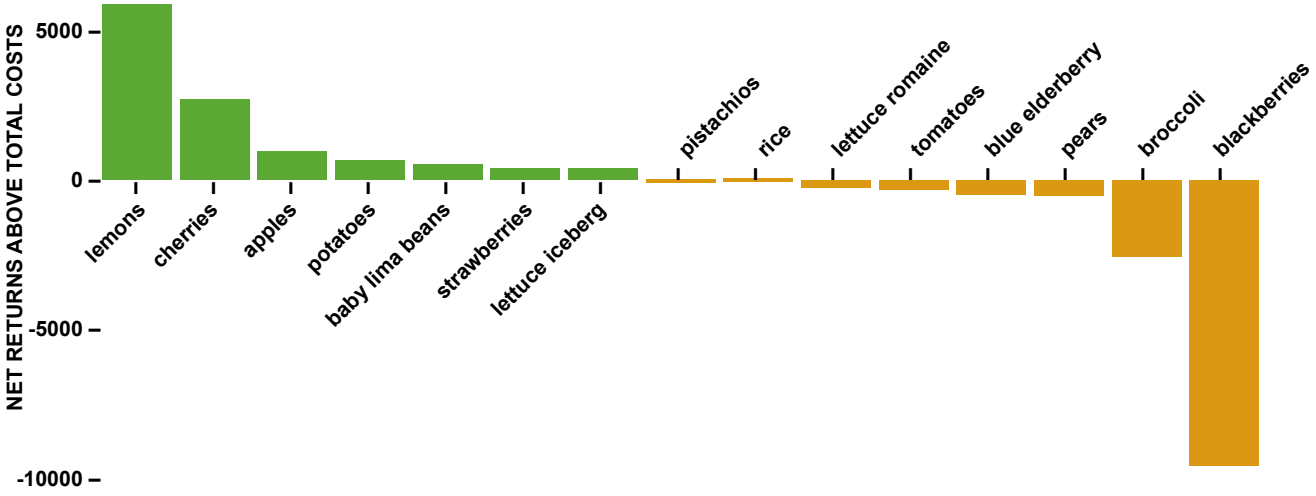


FIGURE 2B: NET RETURNS ABOVE TOTAL COSTS (PER ACRE)



[30] UC Davis – Agricultural and Resource Economics. 2023. Current Cost and Return Studies. Retrieved from: https://coststudies.ucdavis.edu/en/current/

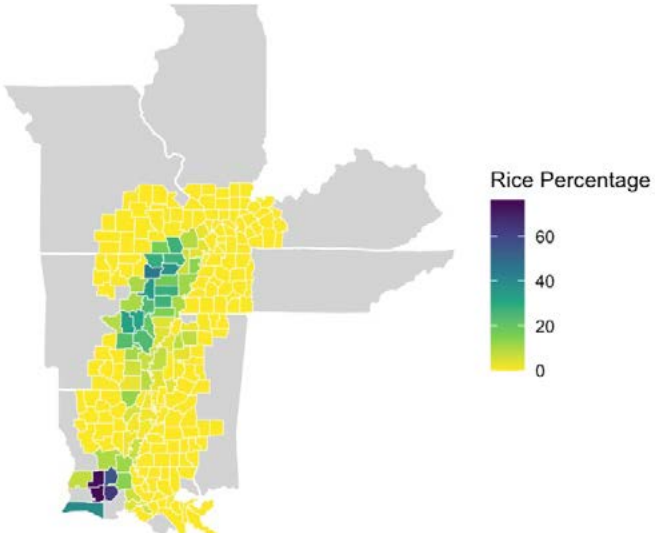
[31] Mississippi State University Extension – Department of Agricultural Economics. 2023. Archived Budget Publications. Retrieved from: https://www.agecon.msstate.edu/whatwedo/budgets/archive.php

Specialty Rice

Only a few states in the country grow rice, and the Delta is a production hub full of the human capital required to develop more entrepreneurial approaches to decommodified rice. This is one crop with some of the highest potential for a shift in production systems from California to the Delta. Specialty varieties related to aromatic jasmine and basmati could be worth exploring, given the area's high water-holding capacity. This region could leverage its existing rice cultivation infrastructure and knowledge base to introduce and expand the production of specialty rice varieties, such as aromatic, saki, black, red, and sushi rice. These specialty varieties typically command higher market prices due to their unique flavor profiles, nutritional content, or specific culinary uses.[32] Furthermore, the demand for such varieties is growing in the United States, driven by shifting consumer preferences towards more diverse and healthier food options.[33]

FIGURE 3B: RICE HARVESTED IN THE DELTA

Harvested Acres of Rice, as Percent of Harvested Cropland Acreage



Successful production and marketing of specialty rice varieties would require addressing several needs. Breeding and agronomic research are required to develop and optimize varieties suited to the specific environmental conditions of the Mississippi Delta.[34] Furthermore, post-harvest handling practices and milling infrastructure may need modifications to maintain the quality attributes of specialty varieties, such as color and aroma.[35] Some of this post-harvest infrastructure is already in development, with mills such as Arkansas River Rice recently beginning operation.[36] Finally, effective marketing strategies must be developed to create awareness and demand for these specialty varieties among consumers, retailers, and restaurants.[37]

Louisiana-based Jazzmen Rice represents an example of specialty rice in the region. The brand's development started in 2009 and aimed to create a locally grown product that could compete with imported jasmine rice varieties. The business model of Jazzmen Rice centers on cultivating, processing, and selling aromatic rice that was bred specifically to thrive in the climate and soils of Louisiana.[38] Critical collaborators included local Louisiana farmers, Louisiana State University, and the Louisiana Department of Agriculture and Forestry.[39] The rice is grown exclusively by local farmers, then processed and packaged for sale under the Jazzmen Rice brand. This approach leverages the appeal of a locally grown, high-quality product to carve out a niche in the rice market, competing not on price but on unique attributes such as taste and aroma and a connection to local agriculture and culture.

[32] *Holcomb, R.B. Evaluating the Effects of Rice Quality Attributes on Consumer Preferences and Rice Demand. Texas A&M University, 1997.*

[33] *Childs, N., & Livezey, J. (2006). Rice backgrounder. United States Department of Agriculture, Economic Research Service. Retrieved from: https://www.ers.usda.gov/webdocs/outlooks/39231/29856_rcs200601_002.pdf?v=5670.5*

[34] *Fitzgerald, M. A., McCouch, S. R., & Hall, R. D. (2009). Not just a grain of rice: the quest for quality. Trends in Plant Science, 14(3): 133-139.*

[35] *Champagne, E. T., Bett-Garber, K. L., Fitzgerald, M. A., Grimm, C. C., Lea, J., Ohtsubo, K., ... & Jongdee, S. (2005). Important sensory properties differentiating premium rice varieties. Rice, 47(4): 309-326.*

[36] *LaRue, C. 2023. "Farmer, mill owner follows grain in Arkansas." Arkansas Democrat Gazette. April 16. Retrieved from: https://www.arkansasonline.com/news/2023/apr/16/farmer-mill-owner-follows-grain/*

[37] *Lusk, J. L., Roosen, J., & Bieberstein, A. (2014). Consumer acceptance of new food technologies: causes and roots of controversies. Annual Review of Resource Economics, 6, 381-405.*

[38] *Benedict, L. (2011). Jazzman competes well in aromatic rice market. LSU AgCenter. https://www.lsuagcenter.com/portals/communications/publications/agmag/archive/2011/summer/jazzman-competes-well-in-aromatic-rice-market.*

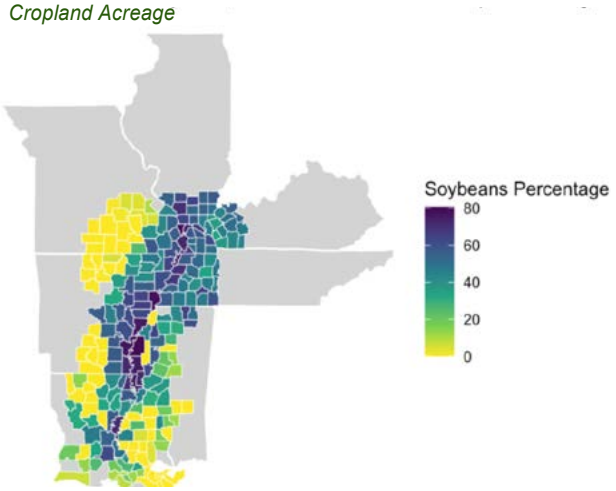
[39] *Sha, X.Y., Linscombe, S.D., Jodari, F., Chu, Q.R., Groth, D.E., Blanche, S.B., Harrell, D.L., White, L.M., Oard, J.H., Chen, M.H. and Theunissen, S.J., 2011. Registration of 'Jazzman'aromatic long-grain rice. Journal of Plant Registrations, 5(3): 304-308.*

Specialty Soybeans

Soybeans have become a dominant presence in American agriculture, and with that growth comes unique value-added opportunities for soybean producers. With its extensive experience in soybean cultivation, the Mississippi Delta has the potential to venture into the production of specialty soybean varieties. Specialty soybeans, such as those bred for edamame or natto production, could become profitable and fit relatively easily within existing farming systems.[40] These specialty soybeans include high-protein, high-oil, low-linolenic, low-saturated fat, and tofu-type soybeans, which typically attract a premium price due to their specific nutritional or industrial qualities.[41] The increased demand for healthy and specialized food products and the industrial use of soybeans provides a promising market for these specialty varieties.

FIGURE 4B: SOYBEANS HARVESTED IN THE DELTA

Harvested Acres of Soybeans, as Percent of Harvested Cropland Acreage



Capitalizing on this potential requires addressing certain needs. Developing and improving soybean varieties that are suitable for the Delta's environmental conditions and meet specific end-use quality parameters is crucial.[42] This calls for substantial investment in breeding programs and agronomic research. The harvesting, storage, and processing infrastructure may also need to be upgraded or modified to prevent cross-contamination and maintain the unique qualities of these specialty varieties. Farmers and agronomists in the region would require training to understand the specific cultivation requirements of these varieties. Similar to the case of aromatic rice, funding for effective marketing strategies is needed to promote these specialty varieties to potential consumers and industries.

There is some history of developing a larger commercial specialty soybean market in the Delta. Pictsweet, a family-owned company based in Tennessee, is a significant player in the American frozen vegetable industry, with operations across the South, including the Mississippi Delta region. Founded in 1945, Pictsweet sources, processes, and packages a wide variety of vegetables, and it is especially recognized for its frozen vegetable offerings, such as edamame.[43]

Specialty Corn Varieties and Other Specialty Grains

Specialty corn, such as popcorn, blue, and sweet corn, could be cultivated in the Mississippi Delta. Varieties such as sweet or colored corn (blue, red) could be successfully grown, potentially supplying local markets and the growing popcorn industry.[44] The region's hot, humid summers might be suited to corn growth, and there is a growing market for specialty corn products. However, these crops may require different cultivation and harvesting methods than the traditional field corn grown in the region, requiring new equipment and knowledge.

Given the right management practices, other specialty grains such as quinoa, amaranth, teff, and millet may thrive in the right location. These grains have been gaining popularity due to their nutritional profiles.[45] While these are still niche markets, consumer interest in healthy, alternative grains is growing. However, the lack of established markets and processing facilities could be a significant challenge, as could potential unfamiliarity with these crops among local consumers.

[40] *Barnes, S. (2010) "The biochemistry, chemistry and physiology of the isoflavones in soybeans and their food products." Lymphatic Research and Biology 8.1: 89-98.*

[41] *Wolfe, E., M. Popp, C. Bazzani, R.M. Nayga Jr, D. Danforth, J. Popp, P. Chen, and H. Seo. (2018) "Consumers' willingness to pay for edamame with a genetically modified label." Agribusiness 34(2): 283-299.*

[42] *Bandillo, N., Jarquin, D., Song, Q., Nelson, R., Cregan, P., Specht, J., & Lorenz, A. (2015). A population structure and genome-wide association analysis on the USDA soybean germplasm collection. The Plant Genome, 8(3).*

[43] *Pictsweet Company. (n.d.). Our Story. https://pictsweetfarms.com/our-farms/*

[44] *Revilla, Pedro, Calli M. Anibas, and William F. Tracy. "Sweet corn research around the world 2015–2020." Agronomy. 11.3 (2021): 534.*

[45] *Wu, G., Ross, C.F., Morris, C.F. and Murphy, K.M., 2017. Lexicon development, consumer acceptance, and drivers of liking of quinoa varieties. Journal of Food Science, 82(4): 993-1005.*

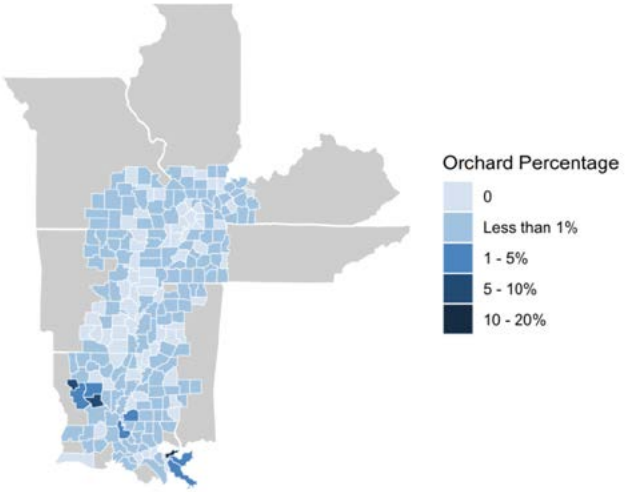
FRUITS

The ecology, infrastructure, and geography of the Delta pose some of the most difficult challenges to the potential development of fruit production. That said, there might be some limited opportunity for expansion in certain crops though anecdotal evidence suggests that the acreage in the Delta associated with any orchard production has declined. For example, the Mississippi State University Department of Agricultural Economics ceased maintaining enterprise budgets for specialty crops more than a decade ago, in 2010.

The figure below displays orchard acres in the Delta as a percentage of harvested cropland acres. The only counties with a high percentage of current orchard acres are those surrounding Baton Rouge and New Orleans, bringing up an important limitation in expanding specialty crops. The Mississippi Delta's relatively remote location presents challenges in accessing markets for crops with short shelf life. The region lacks proximity to the large urban centers on the East and West coasts that often drive specialty crop demand, making it more difficult for these crops to achieve the scale needed for economic viability. This geographic isolation results in higher transportation costs, lowering profit margins and deterring farmers from these cropping systems.[46]

FIGURE 5B: ORCHARD ACRES IN THE DELTA

Acres of Orchards, as Percent of Harvested Cropland Acreage



Blueberries

While most of Mississippi's blueberry production is located in the southern part of the state, some cultivation occurs in the Delta region. The supply chain for blueberries involves growers, processing facilities for freezing or creating value-added products like jams and jellies, and a robust cool chain infrastructure for fresh market berries.[47] Blueberries are a high-value crop that can be grown successfully in the Mid-Delta region, particularly in acidic, well-drained soils. Louisiana and Arkansas both have small but growing blueberry industries. Blueberries could thrive in the Delta's humid climate, with rabbiteye blueberries potentially well-suited to the region's warm temperatures. Blueberries require acidic soil, which can be managed through soil amendments. Commercial blueberry production could offer high returns per acre. However, these crops require a substantial initial investment and a few years to reach full productivity. Disease and pest management, including bird control, could be significant challenges, as could the need for specialized harvesting and post-harvest handling facilities.

Peaches

Culturing peaches in the Mississippi Delta region might be feasible, given the region's climate and soil characteristics. Peaches typically require a certain number of chilling hours (32°F-45°F) during the winter to ensure proper bud development and flowering in spring, with different varieties requiring between 200-1,000 chilling hours.[48] The winter conditions in the Delta region generally provide a suitable range of chilling hours for many peach varieties. The Mississippi Delta's high summer heat and humidity can increase the risk of diseases such as brown rot[49] and peach scab,[50] which require diligent management and preventive measures. Furthermore, peaches are susceptible to late spring frosts that can harm the blossoms and young fruits, requiring careful variety selection and possible use of frost protection methods.[51] In addition, adequate infrastructure for harvesting, storing, and marketing fresh peaches –more perishable than many traditional Delta crops – would need to be established to ensure economic viability.[52]

[46] *Jablonsky, BR. "Rural development through strengthened rural–urban linkages: The case of US local food systems." Economic Development in Rural Areas. Routledge, 2016. 69-82.*

[47] *Hu, W., T. Woods, and S. Bastin. "Consumer acceptance and willingness to pay for blueberry products with nonconventional attributes." Journal of Agricultural and Applied Economics 41.1 (2009): 47-60.*

[48] *Layne, D. and Bassi, D. eds., 2008. The Peach: Botany, Production and Uses. Cabi.*

[49] *De Curtis, F., Ianiri, G., Raiola, A., Ritieni, A., Succi, M., Tremonte, P. and Castoria, R., 2019. Integration of biological and chemical control of brown rot of stone fruits to reduce disease incidence on fruits and minimize fungicide residues in juice. Crop Protection, 119:158-165.*

[50] *Peter, K.A. 2023. Peach Disease – Scab. PennState Extension. https://extension.psu.edu/peach-disease-scab*

[51] *Szewczuk, A., Gudarowska, E. and Deren, D., 2007. The estimation of frost damage of some peach and sweet cherry cultivars after winter 2005/2006. Journal of Fruit and Ornamental Plant Research, 15, p.55.*

[52] *Crisosto, C.H., F.G. Mitchell, and Z. Ju. "Susceptibility to chilling injury of peach, nectarine, and plum cultivars grown in California." HortScience 34.6 (1999): 1116-1118.*

Muscadine grapes

Muscadine grapes are a specialty crop well-suited to the Mid-Delta region's warm, humid climate, particularly in areas with well-drained soils. Mississippi has a small but growing muscadine grape industry. Muscadine grapes, native to the southeastern United States, hold considerable potential for increased cultivation in the Mississippi Delta. This grape variety thrives in hot, humid climates, making the subtropical climate of the Delta an ideal environment for their growth. Moreover, muscadine grapes are well-adapted to the region's soils and are more resistant to pests and diseases that often plague other grape varieties, providing a potential advantage to growers. These grapes have been traditionally used for making jams, jellies, and wines, and the increasing consumer interest in local and unique food products could boost the market for these grapes and their products.

However, commercial cultivation of muscadine grapes in the Mississippi Delta would not be without challenges. Vineyard establishment requires a substantial initial investment and proper site preparation, including installing trellises and an irrigation system. Furthermore, these grapes require careful pruning and management to maintain productivity and fruit quality. Additionally, while muscadine grapes have a unique flavor profile that appeals to some consumers, they may not be as widely accepted as other grape varieties, presenting a potential marketing challenge. Therefore, increasing muscadine grape production would require investments in vineyard infrastructure, management, and efforts to develop and promote markets for these unique grapes and their products.

Watermelons and Other Specialty Melons

With its warm temperatures, lengthy growing season, and rich alluvial soils, the Mississippi Delta region offers a highly conducive environment for watermelon cultivation. Due to these favorable climatic and soil conditions, the Southeastern United States is already one of the nation's major watermelon-producing areas. Expansion might be supported by leveraging agricultural research, modern farming techniques, and technologies. Cultivation methods such as implementing appropriate pest management practices, irrigation methods, and hybrid seed varieties can improve disease resistance and increase yields.[53] The Mississippi Delta could significantly increase its watermelon production by adopting these practices and investing in infrastructure that supports large-scale farming.[54]

Other melons, such as cantaloupes and honeydew, could thrive in the warm, sunny conditions of the Delta. These crops can offer higher returns than traditional commodity crops and can be marketed directly to consumers or restaurants. However, they require well-drained soil and careful water management to prevent diseases such as powdery mildew and pests like the cucumber beetle. As temperatures rise, specialty melons could become more suitable for cultivation in the Mid-Delta region. These crops require warm temperatures and plenty of water, which the Delta region already provides, but could become more conducive to cultivation as temperatures increase.

Blackberries

The Mississippi Delta's climate and soil suit blackberry cultivation.[55] Blackberries could become more suitable for cultivation in the Mid-Delta region as temperatures rise nationally, as blackberries require a certain number of chilling hours in the winter and, in general, the Delta's seasonality will continue to offer cool enough winters. The Mississippi Delta's fertile alluvial soils and warm climate can offer conducive conditions for blackberry cultivation. The region's warm, sunny summers are well-suited to blackberry plants, which require full sunlight for optimal fruit production. The potential for increasing blackberry production might be achieved by leveraging advancements in cultivation methods, implementing effective pest and disease management strategies, and selecting high-yielding

[53] *Snyder, R. (2018). "Watermelon." Mississippi State University Extension Service. Retrieved from https://extension.msstate.edu/publications/watermelon.*

[54] *Evans, C. Consumer Preferences for Watermelons: A Conjoint Analysis. Master's Thesis. 2008.*

[55] *Hu, W., Batte, M.T., Woods, T. and Ernst, S., 2012. Consumer preferences for local production and other value-added label claims for a processed food product. European Review of Agricultural Economics, 39(3): 489-510.*

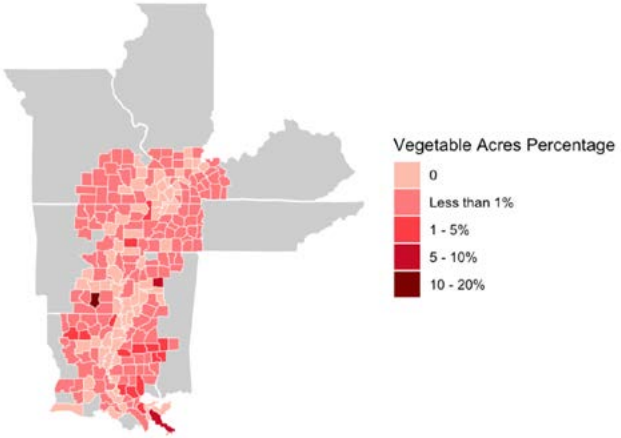
and disease-resistant blackberry varieties. The University of Arkansas has developed several blackberry cultivars that have proven successful in Southern U.S. climates, and these could potentially be used in the Mississippi Delta.[56] Additionally, with growing interest in locally grown, fresh produce, and the nutritional benefits of blackberries, demand for these fruits could support increased production in the region.

VEGETABLES

The Mississippi Delta has a richer history of vegetable production than fruit production. The figure below reports harvested acres of vegetables as a percentage of harvested cropland acreage. Vegetables only account for more than 10 percent in one county in the study region.

FIGURE 6B: VEGETABLE ACRES IN THE DELTA

Harvested Acres of Vegetables, as Percent of Harvested Cropland Acreage



Tomatoes

The region with the largest vegetable production is almost entirely comprised of tomatoes. Heirloom tomatoes could offer a profitable niche for Delta farmers, as these varieties often fetch higher prices than conventional tomatoes. The warm climate of the Delta can support tomato growth, although care must be taken to manage diseases, which can be prevalent in humid conditions. The market for heirloom tomatoes is robust but may require connections with specialty grocers, farmers' markets, or direct-to-consumer sales, as traditional commodity markets may not be suitable. Note the one county with significant vegetable production as a share of agricultural production acreage. This is Bradley County, Ark., which has a rich history of tomato cultivation. It is known for its annual Pink Tomato Festival, which began in 1956, and the county is recognized statewide for its production of pink tomatoes.

The region's tomato production can be traced back to the 1920s. By the mid-20th century, Bradley County was one of the state's leading producers of tomatoes. The region's success with tomato production is due to a combination of suitable soil, climate, and dedicated growers who have developed the infrastructure for tomato production, which involves individual growers, packing sheds, and distributors. In many cases, growers sell their tomatoes to local packing sheds, which then distribute them to retailers. In other cases, growers may sell directly to consumers via farmers markets or roadside stands. However, over the years, the tomato industry in Bradley County, as in many parts of the United States, has faced challenges due to macroeconomic issues in the global market, such as labor issues and regulatory burdens.

Sweet Potatoes

The Mississippi Delta has a strong history of sweet potato cultivation, and its climate and soil are highly suitable for this crop. Sweet potatoes require a long, hot growing season, which aligns with the warm, humid climate of the Delta region. The optimal temperature for sweet potato growth is between 70°F and 85°F, a range commonly reached during the region's long summers.[57] Furthermore, the Mississippi Delta's fertile, sandy loam soils, known for their good drainage, can be ideal for growing sweet potatoes, which are susceptible to root diseases in poorly drained soils.

Despite the region's suitability for sweet potato cultivation, the crop's successful production still depends on careful management practices and overcoming certain challenges.[58] Sweet potatoes are susceptible to various pests, including wireworms, sweet potato weevils, white grubs, and diseases such as black rot and Southern blight, which can significantly affect yields and require effective integrated pest management strategies.[59]

[56] *Crisosto, C.H., F.G. Mitchell, and Z. Ju. "Susceptibility to chilling injury of peach, nectarine, and plum cultivars grown in California." HortScience 34.6 (1999): 1116-1118.*
[57] *Snyder, R. (2018). "Watermelon." Mississippi State University Extension Service. Retrieved from https://extension.msstate.edu/publications/watermelon.*
[58] *Kassali, R. "Economics of sweet potato production." International Journal of Vegetable Science 17.4 (2011): 313-321.*
[59] *Clark, C.A., Ferrin, D.M., Smith, T.P. and Holmes, G.J. eds., 2013. Compendium of Sweet Potato Diseases, Pests, and Disorders (p. 160). St. Paul, MN: APS press.*

Moreover, the labor-intensive nature of sweet potato harvest, often done manually due to the risk of root damage, could pose challenges in a region where labor costs may be high. Nevertheless, the potential for sweet potato cultivation in the Mississippi Delta is significant and can contribute to diversifying the region's agricultural industry.

For example, Vardaman, Miss., is often called the "Sweet Potato Capital of the World." Sweet potatoes have been grown in Vardaman and the surrounding area in Calhoun County since the early 20th century, with the town hosting an annual Sweet Potato Festival that celebrates the importance of the crop to the community. The agribusiness infrastructure supporting sweet potato production in Vardaman includes a network of growers, storage facilities, packing houses, and transportation networks. The region boasts numerous sweet potato farms that provide the base for the industry. Additionally, regional storage facilities enable growers to store their produce for extended periods while maintaining quality, a crucial aspect considering the perishable nature of the crop. Packing houses are critical in grading, cleaning, and packaging sweet potatoes for retail sales. Transportation infrastructure enables product distribution to regional, national, and even international markets. Furthermore, public funding for land-grant colleges provides essential research and development support, helping growers adapt to changing market conditions and maintain a competitive edge in the industry.

Okra

Okra is a heat-loving plant that can thrive in the hot and humid climate of the Delta region.[60] It has been a part of Southern U.S. cuisine for generations, indicating a consistent market demand. There may also be potential to enhance okra yields by adopting advanced farming practices and crop varieties. Appropriate pest and disease management, efficient irrigation systems, and high-yielding, disease-resistant varieties can improve productivity. Okra is a versatile crop, used in various culinary applications, and has potential health benefits that could also help drive demand, further encouraging increased regional production.

Peas

The Mississippi Delta's fertile alluvial soil and warm climate offer an ideal environment for pea cultivation. Southern peas, also known as cowpeas or field peas, are a traditional crop in the Southern United States, including Mississippi. They are heat-tolerant and well-adapted to the local soils and climate, making them an integral part of the region's agricultural production and cuisine.[61] Applied research from land grant universities, including farming technique improvements, pest-management strategies, and higher-yielding pea varieties, can support increasing pea production in the Mississippi Delta. Proper variety selection, timely planting, and disease management can lead to higher yields and improved crop quality. Furthermore, peas have a symbiotic relationship with nitrogen-fixing bacteria, meaning they can improve soil fertility for subsequent crops, thus contributing to more sustainable farming systems.

Pumpkins

Pumpkins are warm season crops that require temperatures around 70°F for optimal growth, conditions typically present in the Delta region during the growing season.[62] The fertile, alluvial soils of the Mississippi Delta, particularly those that are well-drained, could also provide an excellent growing medium for pumpkins. However, successful pumpkin cultivation in the region requires careful consideration of several factors. Pumpkins are susceptible to various pests and diseases, such as cucumber beetles, squash bugs, and powdery mildew, which could be prevalent given the region's warm, humid conditions.[63] Hence, diligent integrated pest management strategies would be important, including disease-resistant varieties and crop rotation. Additionally, the timing of planting and harvesting would need to be carefully managed to coincide

[60] *Andersen, C.R. "Okra," University of Arkansas Division of Agriculture Home Gardening Series, 2013. Retrieved from https://www.uaex.uada.edu/publications/PDF/FSA-6013.pdf*

[61] *"Southern Peas," Mississippi State University Extension, 2023. Retrieved from http://extension.msstate.edu/vegetable-gardening-mississippi/vegetable-varieties/peas-southern.*

[62] *Wilson, J. "Growing Pumpkins for the Home Garden, "Mississippi State University Extension, 2022. Retrieved from: http://extension.msstate.edu/sites/default/files/publications/publications/P2905_web.pdf*

[63] *Egel, D.S., Adkins, S.T., Wintermantel, W.M., Keinath, A.P., D'Arcangelo, K.N., Parada-Rojas, C.H., Rennberger, G., Toporek, S.M., Hausbeck, M.K. and Quesada-Ocampo, L.M., 2022. Diseases of Cucumbers, Melons, Pumpkins, Squash, and Watermelons. In Handbook of Vegetable and Herb Diseases (1-105). Cham: Springer International Publishing.*

with market demand, particularly if the pumpkins are intended for the Halloween market. Despite these challenges, with careful planning and management, pumpkins could become a viable specialty crop in the Mississippi Delta.

OTHER SPECIALTY OPTIONS

There are a few other alternatives that might be worth exploring. Nuts have increased in importance for the region, and there is increased demand for ornamental crops in the United States.

Pecans

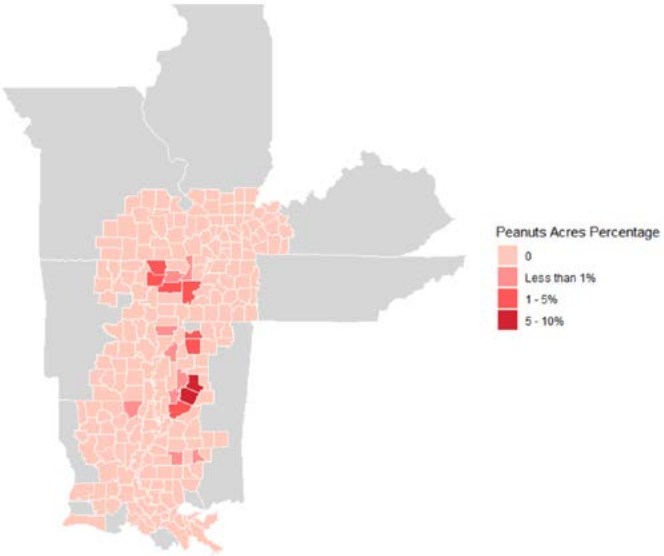
Consumers have increasingly developed a preference for pecans in the United States.[64] Pecans are a specialty crop that can be grown successfully in the Mid-Delta region, particularly in areas with well-drained soil. Pecan trees can tolerate the heavy, clayey soils of the Delta, and the region's long, hot summers promote the growth and ripening of nuts. However, pecan trees require deep, well-drained soils, meaning adequate drainage systems must be established. Furthermore, pecan trees take several years to bear commercially viable yields, requiring farmers to have a long-term perspective and financial sustainability. Diseases like pecan scabs and pests like the pecan weevil can pose significant challenges.

Peanuts

Peanuts are another popular specialty crop well-suited to the Mid-Delta region, particularly in sandy soils.[65] As a warm-season legume, peanuts thrive in the region's hot, long summers. The deep, well-drained sandy loam or silt loam soils of certain parts of the Delta are well-suited to peanut cultivation. Additionally, peanuts have a relatively high tolerance for heat and moderate drought, making them resilient to potential climate variability. Importantly, as a legume, peanuts can fix atmospheric nitrogen, reducing the need for nitrogen fertilizers and potentially improving soil health. However, increasing peanut production in the Mississippi Delta has its challenges. Peanuts require specific equipment for planting, digging, and harvesting, representing a potentially significant upfront investment for farmers. They are also susceptible to several diseases, including leaf spot and tomato spotted wilt virus, which could pose a challenge given the region's high humidity. Despite these challenges, the Mississippi Delta could become a significant player in the peanut industry with the proper management practices and infrastructure development to handle and process peanuts. This shift could benefit the region's farmers economically and contribute to a more diverse and sustainable agricultural landscape.

FIGURE 7B: PEANUT ACRES IN THE DELTA

Harvested Acres of Peanuts, as Percent of Harvested Cropland Acreage



Ornamental Crops

Increased production of ornamental crops such as flowering plants, shrubs, and trees used for decorative purposes might also be worth exploring in this region.[66] The region could leverage its existing agricultural research institutions to explore and adopt the latest cultivation techniques, integrated pest-management strategies, and climate-resilient plant varieties. The rich diversity of ornamental crops, their high value per acre, and the growing demand for nursery products and landscaping plants in urban areas, particularly in the Southeastern United States, underline the potential for ornamental crop expansion in the Mississippi Delta.[67]

[65] *Cheng, G.C., Capps Jr, O. and Dharmasena, S., 2021. Demand analysis of peanuts and tree nuts in the United States: A micro-perspective. International Food and Agribusiness Management Review, 24(3):523-544.*

[66] *Mississippi State University Budget Generator. 2008. Ornamental Crops. https://www.agecon.msstate.edu/whatwedo/budgets/generator/index.php*

[67] *Hall, C.R., Hodges, A.W., Khachatryan, H. and Palma, M.A., 2020. Economic contributions of the green industry in the United States in 2018. Journal of Environmental Horticulture, 38(3): 73-79.*

Part II - A: Labor Needs in the Mississippi River Delta Region to Increase Specialty Crop Production

Decommodified specialty crop production in the Mississippi River Delta region represents a unique opportunity for the agricultural economy, with the potential to contribute significantly to the livelihoods of local communities. As the demand for diverse and high-quality agricultural products continues to rise, there is an increasing need to understand and address the labor requirements associated with specialty crop production. This section looks at the labor needs in the Mississippi River Delta region, with a specific emphasis on the annual labor gaps that are critical for sustained production and growth in this sector. This analysis examines the labor market dynamics and investment landscape in the Mississippi River Delta states of Mississippi, Arkansas, Louisiana, and Tennessee, contrasting them with California's robust agrifood sector. By focusing on this aspect of labor in agriculture, we can gain insights into the challenges and opportunities in ensuring sustainable growth toward commoditized agrifood production systems in the region. The goal is to estimate labor needs and identify opportunities to enhance specialty crop production in the Delta region. The data reveals considerable gaps between the Delta and California in agricultural employment composition and wages, with California dominating high-value specialty crops. The Delta would need to hire thousands more workers to match California's labor share in key specialty crop sectors like vegetables and fruits. There are also disparities in technology investments, with far fewer agrifood ventures funded in the Delta than in leading ag-tech states like California.

However, the data also uncovers the Delta's strengths, like its Greenhouse and Nursery sector, and competitive wage growth in Food Manufacturing. The analysis suggests strategic upskilling and increased technology adoption can compensate for labor gaps and catalyze specialty crop growth. Investment incentives, agricultural training programs, and public-private partnerships can equip the workforce and foster an innovation ecosystem tailored to the region. To fully leverage the Delta's agricultural assets, it is crucial to understand labor dynamics across production stages for specific high-value specialty crops. Further crop-specific analysis of tasks and skills is needed to pinpoint gaps. The development of educational initiatives, favorable policies, and funding opportunities that directly address these gaps will enable the Delta region to pivot toward a more diverse, decommodified agricultural economy centered on specialty crops. In summary, strategic investments in human capital and technology adoption can unlock the Delta's potential to become a specialty crop leader.

Understanding these needs is especially important as agricultural production systems are rapidly evolving. The unique nature of specialty crops, which often require more intensive labor due to their specific cultivation and harvesting needs, underscores the importance of understanding labor dynamics in this sector. In specialty crop production, unique human capital is essential for various activities including planting, maintenance, harvesting, processing, and marketing.

Broadly speaking, agricultural labor markets are characterized by two primary types: seasonal and annual labor. Seasonal labor is typically associated with planting and harvesting periods, which are time-bound and fluctuate with the agricultural calendar. These workers are essential for meeting short-term, high-intensity labor demands, especially for seasonal specialty crop production. Developing any supply chain plan would benefit from thoroughly understanding the labor requirements during peak and off-peak seasons for each specific crop, which requires factors like planting seasons, growing cycles, and harvest times. Migrant labor comprises a large percentage of seasonal specialty crop production labor, with many workers coming via work visas such as H2A.[68] While assessing the feasibility of attracting and retaining such laborers, a study must consider temporary housing, transportation, and wage competitiveness.

This study focuses on the second labor type: annual labor, which is involved in activities beyond the growing season, including ongoing crop maintenance, equipment handling, and other tasks necessary for the year-round functioning of the agricultural sector.

[68] *Williams, O., & Escalante, C.L. (2019). The Economic Importance of Replacement H2A Foreign Farm Labor Inputs. Journal of Agribusiness, 37.1: 53-64.*

This includes tasks such as soil preparation, irrigation management, pest control, and other ongoing activities vital for the health and productivity of specialty crops. Examining annual labor needs is particularly relevant for increasing specialty crop production, as seasonal labor options are constrained by migrant labor policies.[69] Limits on migrant labor access have pushed producers toward labor-reducing technologies via mechanization and plant genetics.[70] As farmers and agricultural enterprises in the Mississippi River Delta region pivot their crop portfolios to include more specialty crops, they have an especially unique opportunity to adopt these labor-saving innovations without the sunk costs of prior investments in more common specialty crop production regions. With that opportunity, we anticipate an increased demand for skilled, reliable, and continuous labor. This shift in crop production patterns necessitates reevaluating the labor force to ensure an adequate supply of skilled workers capable of meeting the year-round demands of 21st-century specialty crop production.

I focus on several key considerations to understand annual labor gaps in the Mississippi River Delta region. First, I assess the region's current labor supply, including the skills, experience, and availability of workers. I then compare that labor supply to California agricultural labor to identify likely gaps. I then examine broader labor market dynamics, including wage rates, as the competitiveness of the agricultural labor market, especially in comparison to other industries, can significantly influence the ability to attract and retain skilled workers for annual labor roles.

The primary analysis indicates a sizable gap between the overall number of agricultural employees between the two regions and the type of annual agricultural labor employed. In the second part of the study, I explore ways that investments might offset and attract additional specialty crop production. Specifically, I compare regional training and skill development programs to other programs and then compare public and private investment gaps in labor-saving innovation and entrepreneurship in the mid-Delta states. These may include policy recommendations, incentives for workforce development, partnerships with educational institutions, and initiatives to enhance the attractiveness of agricultural work. The region might strengthen its agricultural economy by addressing these labor gaps to meet the changing demand for decommodifed specialty crops.

Current Labor Supply

First, this report establishes a baseline of the agrifood labor force in the mid-Mississippi Delta states. I focus on labor along three specific steps of that value chain. Our data come from the Quarterly Census of Employment and Wages (QCEW), a comprehensive employment and wage data program administered by the U.S. Bureau of Labor Statistics. It covers over 95% of U.S. jobs, providing detailed information by industry at county, state, and national levels. This data, which includes the number of establishments, employment figures, and wages, is collected quarterly from unemployment insurance (UI) tax records. For the analysis of labor needs in specialty crop production in the Mississippi River Delta region, the QCEW offers localized employment data, allowing for a detailed understanding of labor market dynamics. This data allows us to identify trends and compare employment levels across regions and industries. We focus on comparing employment levels across different industries or regions over time. We also examine industry average wage trends for our geographic areas of interest.

The broadest employment sector of interest is Agriculture, Forestry, Fishing, and Hunting (NAICS 11), which encompasses jobs integral to producing food, fiber, and other natural resources. Agriculture includes farm workers and laborers involved in crop planting, tending, and harvesting, as well as those managing livestock and dairy production. Forestry jobs involve forest conservation, logging operations, and management of timber tracts. Fishing-related occupations include those working on fishing vessels or in aquaculture to harvest and cultivate marine life. Hunting-related roles might involve managing wildlife reserves or guiding hunting expeditions. Additionally, this sector includes support roles such as agricultural

[69] *Escalante, C.L., Williams, O., Rusiana, H., & Pena-Levano, L. (2019). Costly Foreign Farm Replacement Workers and the Need for H-2A Reforms. Journal of ASFMRA, 14-20.*
[70] *Gallardo, R.K., & Sauer, J. (2018). Adoption of Labor-Saving Technologies in Agriculture. Annual Review of Resource Economics, 10:185-206.*

inspectors, equipment operators, and managers overseeing operations in farms, forests, and fisheries.

Food Manufacturing (NAICS 311) encompasses jobs transforming raw agricultural goods into consumable food products. This includes positions in processing, where workers handle the cleaning, cutting, and packaging items like fruits, vegetables, meats, and dairy. There are also specialized roles in baking, confectionery production, and cheese making, where artisans and technicians blend culinary skills with manufacturing processes. Quality control inspectors, maintenance technicians, and machine operators are essential to ensure that operations run smoothly and standards are met. Additionally, the sector employs food scientists and technologists who work on product development, improving food safety, and extending shelf life. Managers and supervisors oversee production, ensuring efficiency and compliance with industry regulations.

Finally, Grocery and Related Product Merchant Wholesalers (NAICS 4244) involve a range of jobs critical to distributing and supplying food products to retailers, restaurants, and institutions. This sector employs warehouse workers and laborers who handle the loading, unloading, and properly storing food items. Order fillers and packers prepare and manage shipments, ensuring delivery. Sales representatives and customer service personnel work to maintain relationships with buyers and manage orders. Buyers and purchasing agents are responsible for selecting and procuring diverse food products. The sector also includes logistics and transportation coordinators who manage the scheduling and routing of deliveries and inventory managers who track stock levels and ensure product quality. Together, these roles are vital in maintaining the supply chain of food products from producers to consumers.

Table 1B presents data reflecting the percentage of national employment in key sectors associated with agrifood and specialty crop production systems, revealing significant differences between the Mid-Delta states and California, with implications for enhancing specialty crop production in the Mid-Delta. In Agriculture, Forestry, Fishing, and Hunting (NAICS 11), the Mid-Delta's share of national employment is 3.2%, substantially lower than California's commanding 33.4%. This stark contrast suggests that while agriculture is a significant part of both regions' economies, California has a more dominant role nationally, likely due to its vast array of specialty crops, advanced agricultural technologies, and extensive agrifood infrastructure. For the Mid-Delta states to increase their specialty crop production, there is a clear need to expand and develop their agricultural workforce, invest in modern farming techniques, and potentially restructure their agricultural focus to boost their national employment percentage and overall production capabilities.

In the sectors of Food Manufacturing (NAICS 311) and Grocery and Related Product Merchant Wholesalers (NAICS 4244), the Mid-Delta states also show a smaller percentage of national employment compared to California, with 7.7% vs. 9.8% and 4.5% vs. 13.8%, respectively. While the differences are not as pronounced as in primary agriculture, they indicate that California has a more substantial role in processing, manufacturing, and distributing food products nationally. These stages are critical for adding value and marketability to specialty crops. For the Mid-Delta states to enhance their specialty crop production systems, it is crucial to focus on increasing primary agricultural output and bolstering the downstream sectors of food manufacturing and distribution. Strengthening these areas could lead to better market access, higher economic returns for specialty crops, and a more robust agrifood sector that supports and is supported by increased specialty crop production.

TABLE 1B: PERCENTAGE OF NATIONAL EMPLOYMENT, 2022

	DESCRIPTION	MID-DELTA	CALIFORNIA
11	Agriculture, Forestry, Fishing, and Hunting	3.2%	33.4%
311	Food Manufacturing	7.7%	9.8%
4244	Grocery and Related Product Merchant Wholesalers	4.5%	13.8%

Source: 2022 USDA Agricultural Census

Wages

Figures 8B, 9B, and 10B chart the average annual pay in food system private employment since 2001. The graph illustrates a comparison to the national average and suggests that wage rates are unlikely to be the primary driver for transition to mid-Delta agricultural labor expansion. This indicates that there is growth in agricultural wages across the board. For the Mid-Delta states, the challenge lies in ensuring that wage growth does not lag the rest of the country to the extent that it impedes the ability to attract skilled workers necessary for modern agrifood systems. However, the opportunity exists to leverage these consistent wage levels to attract agrifood businesses looking for cost advantages from lower cost-of-living, taxes, and land prices, provided the workforce can be upskilled accordingly.

Figure 8B, which showcases the Quarterly Census of Employment and Wages (QCEW) data of Average Annual Pay for Crop Production (NAICS 111) from 2001 to 2022, indicates a clear upward trend in wages across the board, with California generally being the most expensive relative to the national average. Over the two-decade span, California's average annual pay in crop production has increased from $20,130 in 2001 to $44,617 in 2022. This growth outpaces the national average, which climbed from $19,241 in 2001 to $41,722 in 2022. While also exhibiting growth, the Mid-Delta states (MS, AR, LA, and TN) have done so at a slower pace. Mississippi, for example, increased from $15,869 to $34,721, and the other Mid-Delta states show similar patterns. The consistent wage gap in the Mid-Delta states and California and the national average underscores the regional disparities in wage growth within the agricultural sector. The disparity in wage growth rates between the Mid-Delta states and California could reflect differences in the types of crops produced, with California focusing more on high-value specialty crops that command higher prices and, by extension, can support higher wages. It also highlights the potential need for the Mid-Delta region to invest in similar high-value crops and the technologies that support them to enhance the competitiveness and attractiveness of the agricultural sector in these states.

FIGURE 8B: CROP PRODUCTION (NAICS 111) AVERAGE ANNUAL PAY RELATIVE TO THE NATIONAL AVERAGE

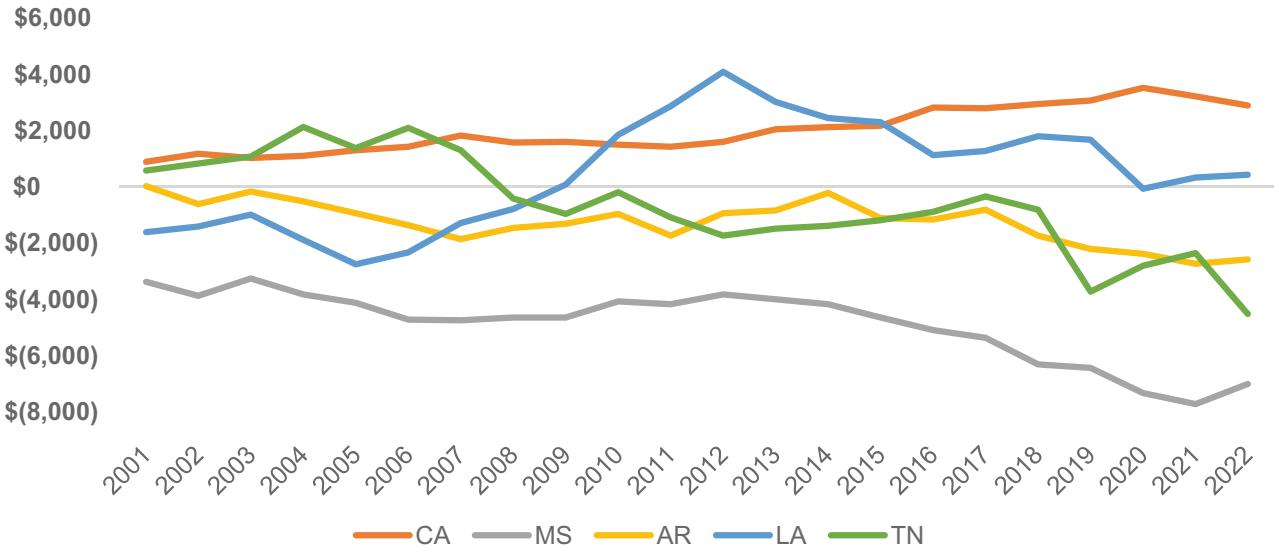
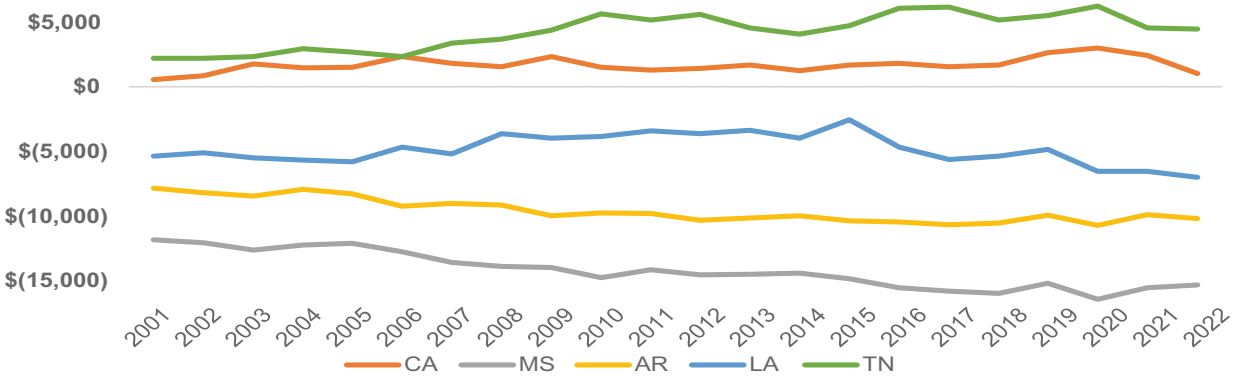


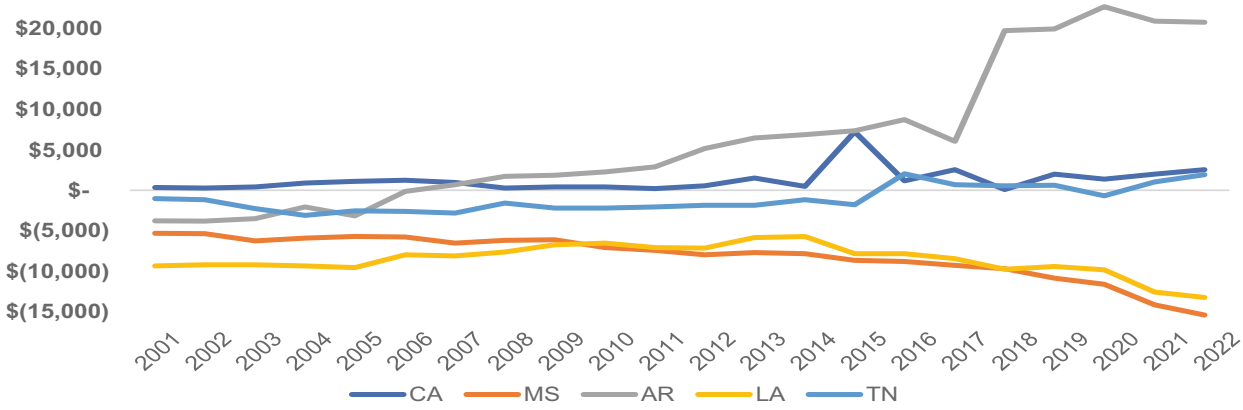
FIGURE 9B: FOOD MANUFACTURING (NAICS 311) AVERAGE ANNUAL PAY RELATIVE TO THE NATIONAL AVERAGE



Since food manufacturing is a critical downstream sector for specialty crops, understanding and potentially addressing these wage disparities is important for ensuring a strong and competitive agrifood sector capable of attracting and retaining skilled labor, which is necessary for the envisioned growth in specialty crop production. Figure 9B displays the QCEW data on Average Annual Pay for Food Manufacturing (NAICS 311) from 2001 to 2022 compared to the national average. Even relative to the national average, California shows a consistent upward trend in wages, rising from $32,542 in 2001 to $58,847 in 2022. The Mid-Delta states—Mississippi, Arkansas, Louisiana, and Tennessee—also display growth in average annual pay, albeit at varying degrees. Notably, Tennessee exhibits a remarkable increase, surpassing the national average in recent years, which indicates robust growth in its food manufacturing sector. In contrast, while showing growth, Mississippi remains below the national average, suggesting a disparity within the region in terms of wage growth. Higher wages in states like Tennessee could reflect a strong demand for labor in food manufacturing, which is essential for processing and adding value to specialty crops. For Mississippi and other Mid-Delta states where wages are below the national average, there may be opportunities to attract investment and develop the food manufacturing sector, which would, in turn, support the specialty crop industry.

Figure 10B displays the QCEW data of Average Annual Pay for Grocery and Related Product Merchant Wholesalers (NAICS 4244) from 2001 to 2022. Californian average pay was $39,393 in 2001, reaching $74,350 in 2022. The Mid-Delta states—Mississippi, Arkansas, Louisiana, and Tennessee—also exhibit a steady increase in average annual pay. Notably, Arkansas shows a substantial leap in average pay over the years, with an increase from $35,223 in 2001 to $92,614 in 2022, surpassing the national average in the later years. This significant wage growth suggests a dynamic development within Arkansas's grocery and related products wholesaling sector, which is unsurprising given the state's outsized role in grocery retail via Walmart, Sam's Club, and Tyson Foods. Given the role wholesalers play in getting crops to market, competitive wages can be a

FIGURE 10B: GROCERY AND RELATED PRODUCT MERCHANT WHOLESALERS (NAICS 4244) AVERAGE ANNUAL PAY RELATIVE TO THE NATIONAL AVERAGE



marker of the sector's strength and its ability to attract a skilled workforce. For the Mid-Delta states, enhancing wages and development within this sector could be key to supporting the expanded production of specialty crops by ensuring a robust system for moving goods from farms to tables. Higher wages in this sector can also lead to increased economic activity and greater investment in the region's agricultural capacities, thereby supporting the broader goals of the current project.

Structural Employment Comparison to California

Just because overall agrifood sector employment is substantially smaller in the mid-Delta states does not mean comparison to California is without value. Indeed, it is unsurprising that the most productive agricultural state (by cash receipts) would also be the highest-employment state. As such, it is also important to understand differences in labor composition between the mid-Delta region and the state of California.

To accomplish this task, we focus our analysis on location quotients (LQ), a statistical measure used to assess the relative concentration or specialization of a particular industry or occupation in one geographical area compared to its concentration in another area. In comparing the percentage of employment in agriculture in the Mississippi Delta to the percent of employment in agriculture in California, a location quotient can provide insights into the relative significance of different labor types within agriculture as an employment sector in these two regions. In this context, location quotients can be interpreted as follows:

- **LQ = 1**: If the location quotient is equal to 1, the specific sector's share of employment in the Mississippi Delta is proportionally similar to that in California. In other words, both regions have a similar level of this type of agricultural employment relative to their overall employment composition.
- **LQ < 1**: If the location quotient is less than 1 (e.g., 0.5), it indicates that the specific sector's share of employment in the Mississippi Delta is lower compared to California. This suggests that the specific agricultural sector is less dominant or significant in the Mississippi Delta than in California.
- **LQ > 1:** If the location quotient is greater than 1 (e.g., 2.0), it implies that that specific sector's share of employment in the Mississippi Delta is higher compared to California. This suggests that the agricultural industry plays a more prominent role in employment in the Mississippi Delta than in California.

Table 2B details the Location Quotients (LQs) for agricultural production across the Mid-Delta states when compared to California, which offers a clear perspective on regional agricultural specializations. For example, Mississippi's soybean farming sector, with an LQ of over 1800, and Tennessee's significant LQ in Nursery and Tree Production suggest highly concentrated industries that surpass the national focus by a considerable margin. These specializations highlight key areas where the Mid-Delta states exhibit significant competitive advantage and potential for further growth, particularly within these sectors.

On the other hand, the relatively low LQs in Fruit and Tree Nut Farming and Vegetable and Melon Farming point to sectors where the Mid-Delta region lags behind California. These areas might benefit from targeted strategies to develop competitive advantages similar to those in the soybean sector. The data also highlights the importance of Greenhouse, Nursery, and Floriculture Production, particularly in Tennessee, suggesting existing infrastructure that could be leveraged for specialty crop production, potentially offering new opportunities for economic diversification and growth within the region's agrifood sector. The modest figures in these sectors suggest room for growth and development, which could be achieved through strategic investments, workforce training, and infrastructure improvements. Enhancing these areas could increase processing capabilities and value-added production for specialty crops, contributing to economic growth and diversification in the region's agricultural output. The disparities between the LQs within the Mid-Delta region and California also shed light on the differing agricultural priorities and capacities of these regions. Addressing these gaps could improve the Mid-Delta's competitiveness in the national market and offer opportunities for job creation and innovation in agriculture-related industries, fostering a more dynamic and resilient agricultural sector.

TABLE 2B: SELECTED AGRICULTURAL PRODUCTION LOCATION QUOTIENTS RELATIVE TO CALIFORNIA

NAICS	DESCRIPTION	MS	AR	LA	TN	MID-DELTA
111	Crop Production	0.73	0.87	1.09	1.33	0.97
1111	Oilseed and Grain Farming	23.28	32.80	13.60	13.96	22.22
11111	Soybean Farming	1829.84	1204.42	650.87	855.29	1190.19
11113	Dry Pea and Bean Farming	-	-	-	5.67	1.17
11115	Corn Farming	42.76	25.79	34.01	28.70	32.85
11116	Rice Farming	3.62	20.12	5.79	-	8.36
11119	Other Grain Farming	30.12	50.49	14.67	21.87	31.37
111191	Oilseed and Grain Combination Farming	76.51	140.76	33.14	59.22	83.37
111199	All Other Grain Farming	5.39	2.38	4.83	1.96	3.65
1112	Vegetable and Melon Farming	0.38	0.14	0.29	1.16	0.45
111211	Potato Farming	2.86	0.26	1.39	-	1.17
111219	Other Vegetable (except Potato) and Melon Farming	0.06	0.12	0.15	-	0.09
1113	Fruit and Tree Nut Farming	0.03	0.03	0.03	0.04	0.03
11133	Noncitrus Fruit and Tree Nut Farming	0.03	0.03	-	0.04	0.02
111331	Apple Orchards	0.00	0.00	-	3.89	0.80
111332	Grape Vineyards	-	-	-	-	0.00
111333	Strawberry Farming	-	-	-	-	0.00
111334	Berry (except Strawberry) Farming	0.09	0.06	0.00	-	0.04
111335	Tree Nut Farming	0.02	-	-	-	0.01
111336	Fruit and Tree Nut Combination Farming	-	-	0.00	-	0.00
111339	Other Noncitrus Fruit Farming	0.00	-	0.00	0.00	0.00
1114	Greenhouse, Nursery, and Floriculture Production	0.57	0.79	1.79	3.99	1.60
11141	Food Crops Grown Under Cover	-	1.22	0.63	3.63	1.25
111411	Mushroom Production	-	0.00	-	7.37	1.52
111419	Other Food Crops Grown Under Cover	-	1.74	-	2.04	0.95
11142	Nursery and Floriculture Production	-	0.66	2.14	4.10	1.50
111421	Nursery and Tree Production	0.77	0.76	2.62	5.01	2.03
111422	Specialty Canning	-	0.43	0.99	1.87	0.73
1119	Other Crop Farming	2.54	2.32	7.42	2.28	3.45
11199	All Other Crop Farming	-	-	0.78	1.70	0.51
11291	Apiculture	0.89	0.66	1.18	-	0.70
1132	Forest Nurseries and Gathering of Forest Products	-	-	5.64	0.00	1.19
1151	Support Activities for Crop Production	0.19	0.24	0.21	0.13	0.20
115112	Soil Preparation, Planting, and Cultivating	1.24	2.05	1.50	0.33	1.35
115113	Crop Harvesting, Primarily by Machine	0.12	0.13	0.27	0.22	0.18
115114	Postharvest Crop Activities (except Cotton Ginning)	0.20	0.20	0.33	0.09	0.20
115115	Farm Labor Contractors and Crew Leaders	-	0.00	0.03	0.05	0.02
115116	Farm Management Services	-	0.24	0.17	0.12	0.13

Table 3B provides location quotients for selected manufacturing sectors, presenting a detailed picture of employment concentration in the Mid-Delta region compared to California. Malt Manufacturing shows an exceptionally high LQ in Mississippi at 22.56 and an even more striking 193.61 in Tennessee, indicating a significant industry focus that far exceeds that of California, suggesting these states have specialized, perhaps even dominant, positions in this manufacturing sector. Conversely, Wet Corn Milling in Louisiana holds an LQ of 130.29, revealing a strong regional specialization absent in its Mid-Delta counterparts. Furthermore, sectors such as Sugar Manufacturing in Louisiana and Soybean and Other Oilseed Processing in Tennessee present notable LQs of 26.21 and 4.83, respectively, which points to a focused industry presence. However, areas like Frozen Food Manufacturing and Fruit and Vegetable Canning display low LQs across the board, indicating less concentration than the national landscape. These LQs underscore specific areas where the Mid-Delta region could expand or enhance operations to support specialty crop production by capitalizing on existing manufacturing strengths and developing complementary, currently underrepresented sectors.

TABLE 3B: SELECTED FOOD MANUFACTURING LOCATION QUOTIENTS RELATIVE TO CALIFORNIA

NAICS	DESCRIPTION	MS	AR	LA	TN	MID-DELTA
311213	Malt Manufacturing	22.56	-	-	193.61	62.84
311221	Wet Corn Milling	-	-	130.29	-	16.82
31131	Sugar Manufacturing	-	-	26.21	0.40	3.50
311224	Soybean and Other Oilseed Processing	-	-	-	4.83	1.46
311813	Frozen Cakes, Pies, and Other Pastries Manufacturing	-	-	-	4.43	1.34
3113	Sugar and Confectionery Product Manufacturing	-	-	3.89	1.76	1.03
31192	Coffee and Tea Manufacturing	-	-	2.79	1.79	0.90
311919	Other Snack Food Manufacturing	-	-	-	2.95	0.89
31134	Fruit and Vegetable Preserving and Specialty Food Manufacturing	-	-	0.26	2.62	0.83
31191	Snack Food Manufacturing	0.14	0.62	0.16	1.19	0.65
31194	Seasoning and Dressing Manufacturing	-	-	1.87	0.53	0.40
312	Beverage and Tobacco Product Manufacturing	-	0.09	0.40	0.58	0.26
311942	Spice and Extract Manufacturing	-	0.08	1.26	0.09	0.22
31193	Flavoring Syrup and Concentrate Manufacturing	-	-	1.20	0.04	0.17
311991	Perishable Prepared Food Manufacturing	0.13	-	0.27	0.26	0.14
311411	Frozen Food Manufacturing	-	-	0.90	-	0.12
311412	Frozen Specialty Food Manufacturing	-	-	0.86	-	0.11
311421	Fruit and Vegetable Canning	-	-	-	0.30	0.09

Table 4B presents Location Quotients (LQs) for merchant wholesalers in the Mid-Delta region, indicating varying levels of specialization relative to California's employment shares. Notably, Livestock Merchant Wholesalers in Mississippi exhibit a remarkably high LQ, suggesting a strong sector focus, while Arkansas shows significant specialization in Poultry and Poultry Product Merchant Wholesalers. These higher LQs reflect areas where the Mid-Delta states could leverage existing distribution networks to enhance the supply chain for specialty crops.

Conversely, lower LQs in sectors such as Fresh Fruit and Vegetable Merchant Wholesalers suggest less concentration in these areas. However, moderate LQs in General Line Grocery Merchant Wholesalers across the Mid-Delta indicate a balanced presence in this sector. Recognizing these strengths and weaknesses is crucial for developing strategies to improve the distribution infrastructure, essential for scaling up specialty crop production and ensuring that these crops reach broader markets efficiently.

TABLE 4B: SELECTED GROCERY WHOLESALING LOCATION QUOTIENTS RELATIVE TO CALIFORNIA

NAICS	DESCRIPTION	MS	AR	LA	TN	MID-DELTA
42441	General Line Grocery Merchant Wholesalers	1.50	1.16	1.60	1.67	1.53
42442	Packaged Frozen Food Merchant Wholesalers	0.73	2.12	1.16	1.87	1.51
42443	Dairy Product Merchant Wholesalers	0.75	1.16	1.29	1.02	1.07
42444	Poultry and Poultry Product Merchant Wholesalers	1.37	2.46	1.69	0.32	1.27
42445	Confectionery Merchant Wholesalers	1.11	1.72	1.20	1.40	1.35
42446	Fish and Seafood Merchant Wholesalers	0.53	0.04	1.69	0.22	0.64
42447	Meat and Meat Product Merchant Wholesalers	0.29	0.69	0.39	0.41	0.43
42448	Fresh Fruit and Vegetable Merchant Wholesalers	0.24	0.15	0.33	0.46	0.33
42449	Other Grocery and Related Product Merchant Wholesalers	1.36	1.28	0.87	0.90	1.05
42451	Grain and Field Bean Merchant Wholesalers	-	2.62	5.87	1.87	2.79
424520	Livestock Merchant Wholesalers	5.46	3.04	0.85	4.54	3.30
42459	Other Farm Product Raw Material Merchant Wholesalers	-	0.45	0.07	0.43	0.27

Table 5B presents the percent of agricultural employment engaged in select categories and the number of additional employees required to make the Mid-Delta's labor composition consistent with California's. The employment percentages in various subsectors of agricultural production within the NAICS framework reveal considerable disparities between the Mid-Delta states (Mississippi, Arkansas, Louisiana, and Tennessee) and California, which have direct implications for the potential growth of specialty crop production in the Mid-Delta. Notably, in categories such as Vegetable and Melon Farming (NAICS 1112) and Fruit and Tree Nut Farming (NAICS 1113), the Mid-Delta's share of national employment is markedly lower compared to California. California boasts a significant 21.1% in Fruit and Tree Nut Farming, underscoring its dominance in producing high-value specialty crops. In comparison, the Mid-Delta's highest percentage in these categories is 7.9% for Tennessee in Vegetable and Melon Farming, signaling a substantial opportunity for growth. To reach a Location Quotient consistent with California, and hence a more competitive stance in specialty crop production, the Mid-Delta region would need to increase its labor force by 46 in Vegetable and Melon Farming and 51 in Fruit and Tree Nut Farming.

In Greenhouse, Nursery, and Floriculture Production (NAICS 1114), the Mid-Delta exhibits a strong employment percentage, with Tennessee leading at 27.2%, surpassing California's 6.8%. The Support Activities for Crop Production (NAICS 11511) sector is pivotal for specialty crop production, with a staggering need for an additional 1,807 employees to match California's Location Quotient. Support Activities for Crop Production (NAICS 11511) comprises a variety of essential agricultural services that support the primary activities of crop production. Jobs in this category include soil preparation services, planting and cultivating, crop harvesting primarily by machine, postharvest crop activities excluding cotton ginning, farm labor contracting and crew leadership, and farm management services. Workers in this sector are involved in tasks such as tilling, plowing, fertilizing, seed spreading, transplanting seedlings, and applying pesticides and herbicides. They also operate machinery for harvesting, provide manual labor for picking and sorting crops, and offer services to maintain the quality of produce postharvest, such as washing, packing, and storing. Moreover, farm labor contractors are crucial in recruiting and managing temporary agricultural labor crews, while farm management services offer specialized expertise in running agricultural enterprises efficiently. These support roles ensure that crops are cultivated and harvested effectively, efficiently, and sustainably.

TABLE 5B: SELECTED EMPLOYMENT PERCENTAGES AS A SHARE OF THE INDUSTRY'S OVERALL AGRICULTURAL EMPLOYMENT AND AN ESTIMATE OF EMPLOYMENT NEEDS TO MAKE THE MID-DELTA REGION'S LOCATION QUOTIENT CONSISTENT WITH CALIFORNIA

NAICS	DESCRIPTION	MS	AR	LA	TN	CA	MID-DELTA	(+/-)
1112	Vegetable and Melon Farming	2.6%	0.9%	2.0%	7.9%	6.8%	3.1%	46
111211	Potato Farming	2.2%	0.2%	1.1%	--	0.8%	0.9%	0
111219	Other Vegetable (except Potato) and Melon Farming	0.4%	0.7%	0.9%	--	6.1%	0.5%	11
1113	Fruit and Tree Nut Farming	0.6%	0.6%	0.6%	0.9%	21.1%	0.6%	51
11133	Non-citrus Fruit and Tree Nut Farming	0.6%	0.6%	--	0.9%	20.3%	0.5%	39
111331	Apple Orchards	--	--	--	0.5%	0.1%	0.1%	0
111332	Grape Vineyards	--	--	--	--	4.4%	0.0%	0
111333	Strawberry Farming	--	--	--	--	6.1%	0.0%	0
111334	Berry (except Strawberry) Farming	0.2%	0.1%	--	--	2.5%	0.1%	1
111335	Tree Nut Farming	0.1%	--	--	--	3.9%	0.0%	0
111336	Fruit and Tree Nut Combination Farming	--	--	--	--	0.9%	0.0%	0
1114	Greenhouse, Nursery, and Floriculture Production	3.9%	5.4%	12.2%	27.2%	6.8%	10.9%	-176
11141	Food Crops Grown Under Cover	--	2.0%	1.0%	5.8%	1.6%	2.0%	-3
111411	Mushroom Production	--		--	3.5%	0.5%	0.7%	-1
111419	Other Food Crops Grown Under Cover	--	2.0%	--	2.3%	1.1%	1.1%	0
11142	Nursery and Floriculture Production	--	3.5%	11.2%	21.4%	5.2%	7.8%	-80
111421	Nursery and Tree Production	2.9%	2.8%	9.7%	18.6%	3.7%	7.5%	-113
111422	Specialty Canning	--	0.7%	1.5%	2.9%	1.5%	1.1%	2
1119	Other Crop Farming	6.2%	5.7%	18.1%	5.6%	2.4%	8.4%	-199
11511	Support Activities for Crop Production	10.3%	12.7%	11.4%	7.1%	53.5%	10.6%	1,807
115112	Soil Preparation, Planting, and Cultivating	3.4%	5.7%	4.1%	0.9%	2.8%	3.7%	-15
115113	Crop Harvesting, Primarily by Machine	0.2%	0.2%	0.4%	0.3%	1.5%	0.3%	1
115114	Postharvest Crop Activities (except Cotton Ginning)	2.0%	1.9%	3.2%	0.8%	9.7%	2.0%	60
115115	Farm Labor Contractors and Crew Leaders	--	--	1.3%	1.7%	36.7%	0.6%	88
115116	Farm Management Services	--	0.7%	0.5%	0.3%	2.8%	0.4%	4

Labor Saving Technology Investments

As we move beyond the comparative analysis of labor, it is crucial to consider the role of innovative mechanization and advanced equipment in the agricultural landscape. Strategic investments in labor-saving technologies become imperative in regions like the Mid-Delta, where the labor pool for specialty crop production may be smaller or less developed compared to California. Such technologies, which can range from automated irrigation systems to robotic harvesters, compensate for the labor shortfall and enhance efficiency and productivity. This section will delve into the investment climate in agricultural technology, contrasting the robust ecosystem of California with its high levels of funding and innovation against the more modest but growing environment in the Mid-Delta region. While California benefits from a culture of innovation and a wealth of venture capital, the Mid-Delta region's focus has traditionally been more on immediate, practical solutions to its unique agricultural challenges. This contrast in investment landscapes shapes the potential trajectory of each region's agricultural sector, influencing their respective abilities to adopt new technologies and attract the necessary human capital for advancing specialty crop production. However, there is potential for growth through initiatives such as the Agrifood Innovation Summit in Arkansas, which seeks to connect local agrifood entrepreneurs with investors.

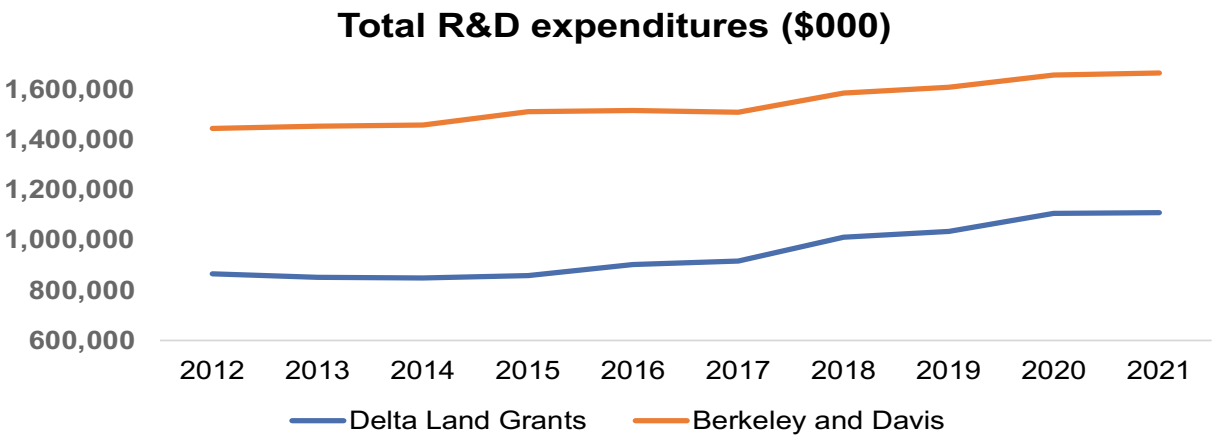
Public Investment in Agrifood Technology

It is important to emphasize the role of machinery and specialized equipment in reducing manual labor, particularly in a region with a smaller labor pool. The investment landscape in agricultural technology (agritech) and the focus of academic institutions in California and the Mississippi River Delta region reveal stark contrasts. Figure 12B presents the total R&D expenditures for universities in the two regions. With globally renowned agricultural research universities like University of California – Davis and University of California – Berkeley, California is a hub for cutting-edge agritech research and development. These institutions often have substantial funding and strong industry ties, enabling advanced studies in biotechnology, sustainable farming practices, and precision agriculture. The state's rich venture capital environment further accelerates agritech innovation, attracting startups and established companies.

In contrast, universities in the Mississippi River Delta region, though actively involved in agricultural research, often concentrate on addressing the unique agricultural challenges of the region, such as soil and water management in flood-prone areas, and may have less access to the high levels of funding seen in California. The emphasis here is more on practical, immediately applicable solutions that cater to the region's specific needs in traditional and specialty crop production. This results in a more regionally tailored approach to agritech, with less emphasis on the broader, more experimental technologies seen in California.

FIGURE 11B. TOTAL RESEARCH AND DEVELOPMENT EXPENDITURES AT THE LAND GRANT UNIVERSITIES IN THE MID-DELTA, UC-BERKELEY, AND UC-DAVIS

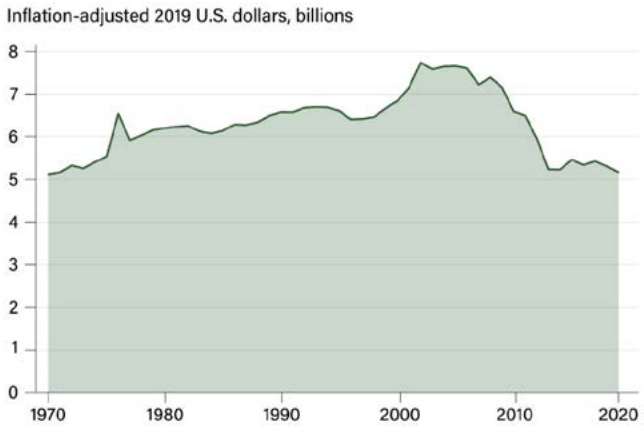
Note: Data from NSF Rankings by total R&D expenditures. Delta Land Grants include U. Arkansas, Fayetteville, Mississippi State U., U. Tennessee, The, Knoxville, Louisiana State U., Baton Rouge, U. Arkansas, Pine Bluff, Alcorn State U., Tennessee State U., and Southern U. and A&M C., Agricultural Research and Extension Center.



Private Investment in Agrifood Technology

Public funding for U.S. agricultural research has famously declined, leading to corresponding declines in agricultural productivity gains. The figure below presents these changes, with public spending dropping to levels not seen since 1970. This decline in funding has contributed to a notable decline in agricultural productivity growth, causing grounds for concern from researchers.[71]

FIGURE 12B. PUBLIC SPENDING ON AGRICULTURAL RESEARCH AND DEVELOPMENT IN THE UNITED STATES



Notes: Spending on public agriculture R&D includes Federal, State, and non-Government funds used for food, agriculture, and forestry research by USDA, land-grant universities, and other cooperating institutions. Spending is in constant 2019 dollars adjusted for inflation using the National Institutes of Health Biomedical Research and Development Price Index. The spike in R&D spending in 1976 is due to an adjustment in the Federal fiscal year in which 1979 included five quarters of spending.

Source: USDA, Economic Research Service (ERS) using data from the ERS data product Agricultural Research Funding in the Public and Private Sectors.

In response, private investment has become critical for developing agricultural ecosystems, with $28 billion invested in agrifood tech firms globally in 2020 alone. Figure 13B maps the number of companies invested by venture capital (VC) and other private investments in agrifood technology by state. The Southern states are often under-represented in funding, while firms in the Western states generally receive the preponderance. For example, California received 20% of all global investments ($5.6 billion), with 691 companies receiving deals between 2020 and 2023. The differences in investment in agrifood technology between the mid-Delta region and California are quite pronounced, reflecting broader trends in venture capital distribution and technological development. This heavy investment is likely due to the state's established tech ecosystems, market access, and a robust network of investors and innovators. The culture of innovation in California and its substantial support for agritech startups have fostered a fertile ground for cutting-edge agricultural technologies, ranging from sustainable farming practices to advanced supply chain solutions.

By contrast, the mid-Delta region has seen relatively modest investment in agrifood technology, with only 89 firms receiving deals in Arkansas, Mississippi, Louisiana, and Tennessee combined. This underrepresentation in venture capital funding could be attributed to several factors, including less developed tech ecosystems, fewer networking opportunities, and possibly more regulatory or market barriers. Despite these challenges, the potential for growth in the Southern states remains significant, given their agricultural prowess and emerging tech hubs. For example, the University of Arkansas recently hosted its inaugural Agrifood Innovation Summit, connecting potential funding opportunities with entrepreneurs in the area.[72] By engaging in additional collaborative efforts, these regions can harness their agricultural strengths and develop a more robust agrifood tech sector, which is vital for economic growth and the advancement of sustainable and efficient agricultural practices.

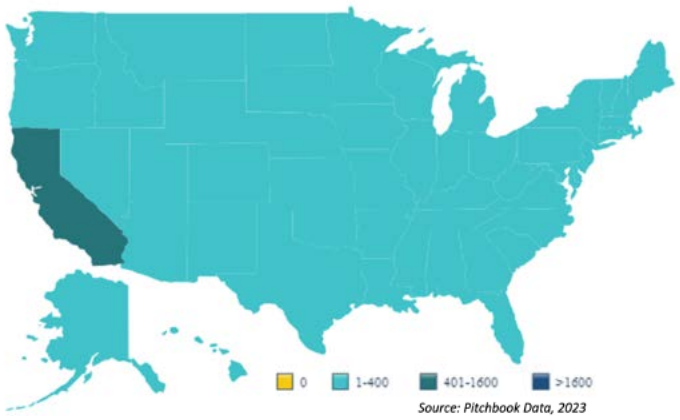
It would be worth exploring how investment incentives and subsidies impact the willingness of individuals and businesses to invest in the agrifood sector (Graff, Silva, & Zilberman, 2020).[73] Favorable tax policies or grants for technology adoption can stimulate investment in advanced agricultural practices and help to identify incentives to encourage investment in the agrifood sector. These might include tax breaks for agrifood companies, subsidies for purchasing advanced farming equipment, grants for sustainable farming practices, or funding for agritech startups.

[71] *Pardey, P.G., & Alston, J.M. (2021). Unpacking The Agricultural Black Box: The Rise and Fall of American Farm Productivity Growth. Journal of Economic History, 81(1), 114-155.*

[72] *Haigwood, W. 2024. Agricultural innovation series, part 1: Collaboration begets commercialization. Delta Farm Press, January 2.*

[73] *Graff, G.D., Silva, F., & Zilberman, D. (2020). Venture capital and the transformation of private R&D for agriculture. Economics of Research and Innovation in Agriculture; University of Chicago Press: Chicago, IL, USA.*

FIGURE 13B. AGTECH COMPANY COUNTY BREAKDOWN BY STATE-LEVEL GEOGRAPHY



Human Capital Investment

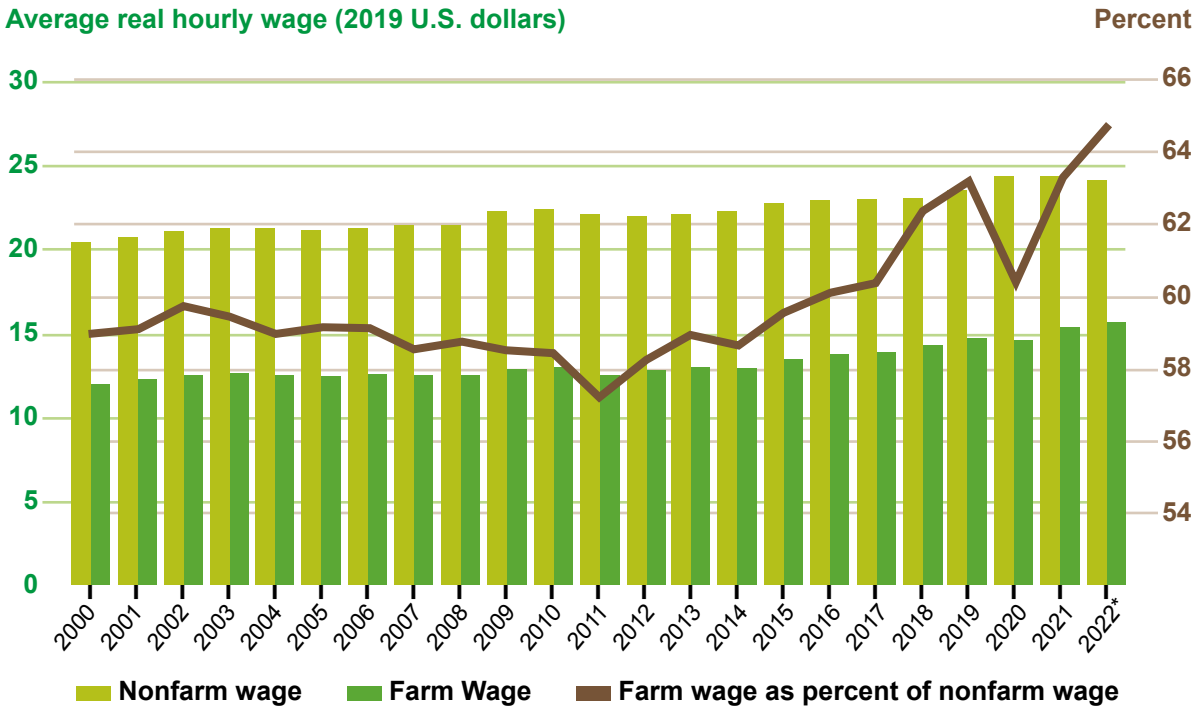
One way to increase specialty crop support services is to increase funding for educational attainment in regional agrifood training programs.[74] The need for specialized training and education in the Mississippi River Delta region's specialty crop production can be addressed through ongoing programs. For example, local community colleges and agricultural schools offer courses specifically designed for the skills needed in specialty crop production. These include programs focused on sustainable farming practices, pest management, and greenhouse operations, providing practical, hands-on experience crucial for the industry. Partnerships between universities and local farms can create opportunities for experiential learning. Programs like internships and apprenticeships on specialty crop farms offer real-world experience in crop management and controlled environment agriculture. This approach bridges the skill gap and helps students gain a deeper understanding of the challenges and rewards of specialty crop farming. Furthermore, extension services and nonprofit organizations in the region can develop workshops and training sessions for existing farmers and new entrants. These programs often focus on innovative farming techniques, financial management, and market access strategies specific to specialty crops. By providing access to such resources, these initiatives play a critical role in ensuring that the labor force is equipped with the necessary skills to thrive in the evolving agricultural landscape.

While it is outside of this analysis, future studies might identify and list all educational institutions (universities, community colleges, trade schools) in the Mid-Delta region that offer agricultural programs with a focus on programs in agricultural science, agribusiness, horticulture, crop science, and similar fields. For each institution, a researcher might gather data on the number of agricultural programs offered, program levels (certificate, associate, bachelor, master, doctorate), and the focus or specialization of each program. This might involve contacting institutions directly or searching for educational statistics from state or regional education departments to obtain statistics on the enrollment numbers for each program and their completion rates and catalog the specific focus areas or specialties of each program.

There would be value in assessing how educational incentives influence the availability and quality of agricultural education and training programs. For example, scholarships, grants, student loan forgiveness programs for agricultural studies, and funding for agricultural research institutions might increase human capital in the sector. Furthermore, there would be value in compiling a list of current state and federal policies constraining labor in the agrifood sector. This includes agricultural zoning laws, labor regulations, tax incentives, and environmental regulations directly impacting farming and related activities. Labor markets can be competitive, and the transition to specialty crops may face challenges in attracting and retaining skilled laborers, especially if competing industries offer higher wages or better working conditions. Figure 14B displays U.S. farm and nonfarm wages over time. Note that farm wages are less than 66% of nonfarm wages.

[74] *This analysis would benefit from added interviews with local farmers, agricultural companies, and program graduates to get qualitative insights into the effectiveness and relevance of the training programs.*

FIGURE 14B U.S. FARM AND NON-FARM WAGES, 2000-22



Note: * = Annual values for 2022 were predicted using incomplete data and year-to-date comparisons with 2021.
Real wages are adjusted for inflation an pegged to 2019 values.

Source: USDA, Economic Research Service using data from USDA, National Agricultural Statistics Service's Farm Labor Survey and U.S. Department of Labor, Bureau of Labor Statistics' Current Employment Statistics.

Discussion

Future research would benefit from crop-specific analysis, requiring a thorough understanding of market access. Specifically, exploring market opportunities for specialty crops both within and outside the region is important, ensuring farmers have access to markets where they can profitably sell their specialty crops. Different specialty crops may have varying labor demands, so there may be a need to conduct crop-specific analyses to understand the nuances and labor requirements. For example, labor needs for berry farming differ from those of organic vegetable production. Once a specific crop was selected, one could break down the agricultural production process into specific tasks required for specialty crop cultivation, from planting and tending to harvesting and packaging. A researcher could then estimate the labor hours and types of skills needed for each task. By understanding where the gaps and opportunities lie, educational institutions, policymakers, and industry leaders can make informed decisions to develop and improve training programs, ultimately enhancing the region's agrifood labor force.

Part II - B: Unique Approaches or Business Models in the Mid-Delta

This section explores innovative business models for enhancing specialty crop production in the Mid-Mississippi Delta. As pivotal support systems, we focus on value-added products, producer-owned cooperatives, university-backed research and development, and geographic indicators. These strategies aim to overcome barriers, such as the lack of local processing facilities and the need for industry-specific research, by leveraging collaborative efforts and innovative solutions. By examining these unique business models, the manuscript sets the stage for a comprehensive discussion on fostering a supportive environment for specialty crops, promising to enhance the economic and environmental sustainability of the Mid-Mississippi Delta's agricultural sector.

Unique Business Models

Despite the exceptional value propositions the Mid-Mississippi Delta region offers, a wholesale shift in regional production will require novel business models to support an all-new, reimagined food system. Typically, developing a novel industry at a commercial scale requires standardized vertical contracts. For example, there is some history of developing a larger commercial specialty soybean market in the Delta. Pictsweet, a family-owned company based in Tennessee, is a significant player in the American frozen vegetable industry, with operations across the South, including the Mississippi Delta region. Founded in 1945, Pictsweet sources, processes, and packages a wide variety of vegetables, and it is especially recognized for its frozen vegetable offerings, such as edamame. Their development could be considered a "traditional" route toward specialty crop profitability. By contrast, this report section explores the costs and benefits of these business models and approaches. We focus on four unique support system approaches: value-added products, producer-owned cooperatives, University support of specialty crop-specific research and development, and geographic indicators.

Value-Added Product Support

For many specialty crops, value-added processing can enhance their economic viability. The Mississippi Delta region currently lacks substantial processing and aggregation facilities, a significant barrier for specialty crop producers. Without local processing, producers are limited to selling raw commodities, which often fetch lower prices than processed products and typically require close proximity to population-dense urban markets. By contrast, farmers might add value to their specialty crops by processing them into value-added products such as jams, jellies, and sauces. This process can increase profits for farmers and create new market opportunities for their crops. Developing value-added support services is particularly well-suited for smaller-scale farmers who may need more resources to produce a high volume of crops but can add value through processing. Support services in this space are often labeled "innovation hubs" or "innovation networks."[75] State-level policies can sometimes induce additional value-add by reducing production and distribution costs via deregulation.[76] Agri-food entrepreneurship support organizations such as food hubs and university innovation centers can play a critical role in helping to assist a new industry. Assessing stakeholder needs is critical, as entrepreneurial assistance programs and food hubs have increased in the past few decades.[77] Along with that proliferation comes the potential for inflating speculative bubbles, which have a history of painfully recurring in the agri-food sector.[78]

Value-added innovation support services in the Mid-Mississippi Delta region could create opportunities for specialty crops by providing the necessary infrastructure for processing, packaging, and marketing. These services could support local farmers by turning raw agricultural products into higher-value items, such as preserves, artisanal cheeses, or health-focused products, increasing their market appeal and profitability. By fostering collaboration between farmers, researchers, and entrepreneurs, these services would also promote the development of new products and technologies, enhancing the competitiveness of the region's agricultural sector in national and international markets.

[75] *Batterink, M.H., Wubben, E.F., Klerkx, L., & Omta, S.W.F. (2010). Orchestrating innovation networks: The case of innovation brokers in the agri-food sector. Entrepreneurship and Regional Development, 22(1), 47-76.*

[76] *Malone, T., & Lusk, J. L. (2016). Brewing up entrepreneurship: Government intervention in beer. Journal of Entrepreneurship & Public Policy, 5(3), 325-342.*

[77] *Berti, G., & Mulligan, C. (2016). Competitiveness of small farms and innovative food supply chains: The role of food hubs in creating sustainable regional and local food systems. Sustainability, 8(7), 616-647.*

[78] *Saitone, T.L., & Sexton, R.J. (2007). Alpaca lies? Speculative bubbles in agriculture: Why they happen and how to recognize them. Applied Economic Perspectives & Policy, 29(2), 286-305.*

One effective example of a value-added support service increasing market access for specialty crop producers in the United States is the USDA's Value-Added Producer Grant (VAPG) program. This program provides grants to producers for planning activities and working capital for marketing value-added agricultural products and farm-based renewable energy. The VAPG program enables farmers to convert their raw products into processed goods, adding value and creating a market-ready product. For instance, a producer of heirloom tomatoes might use VAPG funds to develop, produce, and market heirloom tomato sauces, salsas, or juices.

This approach opens new revenue streams for farmers and helps create brand recognition for their products in local and national markets. By providing financial support for these initiatives, the VAPG program helps reduce the risk of developing new products and entering new markets. Additionally, the program supports the creation of detailed business and marketing plans, ensuring that producers have a solid foundation to build their value-added ventures. As a result, specialty crop producers can more effectively reach consumers looking for locally produced, unique, and artisanal food products, thereby increasing their competitiveness and presence in a crowded marketplace. Indeed, programs like the VAPG facilitates expanding market access for specialty crop producers, encouraging innovation and diversification in the agricultural sector.

Specialty Crop-Specific Research and Development
Large-scale commodities often use checkoff boards to leverage university research focusing on needs for their specific industry. This checkoff approach can put smaller commodities at a disadvantage, as that money rarely translates to niche focuses with less institutional path dependency. One alternative strategy worthy of exploration would be a fund earmarked for research and development in specialty crops in the region. One such example is Michigan State University's Project GREEEN (Generating Research and Extension to meet Economic and Environmental Needs) at Michigan State University, which represents a significant initiative to advance the state's economy through plant-based agriculture. Over the last few decades, the fund has support work on critical issues within Michigan's plant agriculture. Its mission is to produce industry-driven research and outreach that might significantly enhance plant agriculture. Examples of enhancements include research and educational programs tailored to industry needs, ensuring and improving food safety, and protecting and preserving environmental quality. As a cooperative effort, it combines the expertise of plant-based commodity groups, regional agribusinesses, Michigan State University AgBioResearch, Michigan State University Extension, and the Michigan Department of Agriculture and Rural Development.

A similar approach could benefit the Mid-Mississippi Delta region in its efforts to increase specialty crop production. By focusing on industry-driven research and outreach, a similar fund could induce collaboration between agricultural researchers, extension services, commodity groups, and state departments to address critical challenges and opportunities in plant agriculture throughout the region. Akin to Michigan, a similar model could lead to the development of regionally tailored agricultural practices that enhance yield, improve soil health, and ensure environmental sustainability, all of which are crucial for the successful expansion of specialty crop production in the region.

Similarly, creating a research fund earmarked for improving food safety and protecting environmental quality would align well with the needs of the Mid-Mississippi Delta. Given its unique climatic and soil conditions, this region could benefit from research and extension efforts focusing on sustainable water management, pest control, and crop diversification. A Mid-Mississippi Delta "Fund" could accelerate the adoption of innovative practices and technologies by leveraging a cooperative approach that engages local farmers, agricultural businesses, and research institutions. Creating a similar fund might boost specialty crop production and contribute to the region's economic vitality, ensuring that its agricultural sector remains competitive and sustainable in the face of evolving environmental and market conditions.

A strategic approach focusing on collaboration, research, and community engagement would be essential to develop a specialty crop-specific research and development program in the Mid-Mississippi Delta Region. As with any initiative, a first step would be to establish a coalition of local stakeholders, including farmers specializing in specialty crops, agricultural businesses, research institutions, and government agencies. This coalition could identify the unique challenges and opportunities within the region's agricultural sector, particularly those related to specialty crop production. The program would need to actively seek funding and support from public and private sources, including state departments of agriculture, federal agricultural programs, and private foundations interested in sustainable agriculture. Indeed, establishing partnerships with existing extension services would also be crucial to directly disseminate research findings and best practices to farmers and agricultural businesses. By creating a feedback loop between researchers and the agricultural community, the program might ensure that its initiatives are relevant and practical. Training and educational workshops, demonstration projects, and farmer-led innovation networks could serve as effective platforms for knowledge exchange.

One example of a commodity that might benefit from this approach is the sweet potato industry, characterized by ongoing research support, especially in 1890s land grant institutions. Vardaman, Miss., is often called the "Sweet Potato Capital of the World." Sweet potatoes have been grown in Vardaman and the surrounding area in Calhoun County since the early 20th century, with the town hosting an annual Sweet Potato Festival that celebrates the importance of the crop to the community. The agribusiness infrastructure supporting sweet potato production in Vardaman includes a network of growers, storage facilities, packing houses, and transportation networks. The region boasts numerous sweet potato farms that provide the base for the industry.

That said, sweet potatoes do not have a checkoff program, nor do they have industry-specific funding to conduct research. By establishing stable funding for this program, producers might have access to university resources like that of larger crops such as soybeans or rice.

Cooperatives

Agri-food production systems require extensive fixed costs to create the assets necessary to harvest and process the crops. Regional storage facilities enable growers to store their produce for extended periods while maintaining quality, a crucial aspect considering the perishable nature of the crop. Packing houses are critical in grading, cleaning, and packaging sweet potatoes for retail sales. Transportation infrastructure enables product distribution to regional, national, and even international markets. One way to increase access to funds to afford these expensive fixed costs is through a cooperative model, which allows producers to pool their resources and share the costs of production, processing, and marketing. This approach can give farmers greater bargaining power, help reduce costs, and create a sense of community among farmers. Cooperatives can be particularly suitable for smaller-scale farmers needing more resources to invest in expensive equipment or marketing campaigns.

U.S. farmer cooperatives play a pivotal role in supporting farmers who grow specialty crops by providing a collective platform to access markets, share resources, and leverage economies of scale. These cooperatives allow individual farmers to pool their production, leading to better negotiation power for selling their crops, access to larger markets that would be difficult for a single farmer to reach, and the ability to share the cost of marketing and distribution. For specialty crops, which may require specific marketing strategies due to their unique qualities or niche consumer bases, cooperatives can offer targeted support in branding and finding the right market channels. Moreover, cooperatives often provide their members with technical support, including access to research on sustainable practices, pest management, and soil health improvement, which are critical for the successful production of specialty crops. This support system is vital for farmers looking to diversify their crops or transition to growing specialty crops, as it reduces the individual risk and investment required to enter new markets.

Farmer cooperatives in the United States are especially supportive of specialty crop growers by advocating for policies that benefit specialty agriculture and facilitating access to government programs designed to support the sector. For instance, cooperatives can help farmers navigate the complexities of organic certification, apply for grants for sustainable agriculture practices, or participate in federal and state programs offering financial assistance for crop insurance and conservation efforts. By acting as a unified voice, cooperatives have the power to influence policy decisions and ensure that the needs of specialty crop producers are considered in agricultural legislation and funding. Ultimately, the collaborative nature of farmer cooperatives not only strengthens the economic position of individual farmers but also contributes to the resilience and sustainability of the broader agricultural community, especially those focused on cultivating specialty crops.

Farmer cooperatives in the mid-Mississippi Delta region have the potential to boost specialty crop production by leveraging collective resources, knowledge, and market access. By uniting small and medium-sized farms under a cooperative model, these farmers might achieve larger economies of scale, creating the opportunity for investments in the infrastructure necessary for cultivating, processing, and marketing. Cooperatives can facilitate access to shared resources such as advanced irrigation systems, organic certification processes, and sustainable farming practices tailored to the unique climatic and soil conditions of the Delta. Additionally, by pooling resources, cooperatives can more effectively market these crops, identifying niche markets and creating brand recognition for Delta-grown specialty products. This collective approach reduces individual risk and amplifies bargaining power with buyers, leading to better pricing, increased income for farmers, and the economic revitalization of the region through agriculture. Through education, advocacy, and shared investment, farmer cooperatives could transform the agricultural landscape of the mid-Mississippi Delta by making specialty crop production a cornerstone of the region's economy.

The initial step would be to conduct outreach and education within the farming community to raise awareness about agricultural cooperatives. Workshops, seminars, and farm visits can be organized with local agricultural extension services, universities, and successful cooperatives from other regions to share knowledge and experiences. These educational efforts should highlight how cooperatives can help farmers access new markets, share costs, and improve production practices, particularly for specialty crops that may require more sophisticated marketing and distribution strategies. Additionally, creating a platform for dialogue among farmers can facilitate the exchange of ideas and foster a sense of community and mutual support, laying the groundwork for cooperative formation.

Parallel to these community engagement efforts, developing financial incentives and support structures is crucial for encouraging the establishment of new cooperatives. This could involve securing start-up grants, offering tax incentives, and providing access to low-interest loans specifically designed for cooperative development. Collaboration with state and federal agricultural agencies to tailor existing support programs to the needs of cooperatives can also be beneficial. Furthermore, establishing a regional cooperative development center could provide emerging cooperatives with ongoing technical support, legal advice, and business planning services. Such a center could act as a hub for best practices, innovation, and advocacy, ensuring that cooperatives in the mid-Mississippi Delta region are formed and thrive.

Geographic Indicators

Geographic indicators are exceptionally popular in Europe; there are 3,286 registered GIs in the EU.[79] For example, European producers sometimes use quality labels such as Protected Designation of Origin, Protected Geographical Indication, and Traditional Specialty Guaranteed.[80] Protected Designations of Origin (PDO), Protected Geographical Indications (PGI), and Traditional Specialty Guaranteed (TSG) are three European Union schemes aimed at promoting and protecting names of quality agricultural products and foodstuffs. These labels help identify products that have a specific geographical origin and possess qualities, reputation, or characteristics inherent to that location.

[79] *De Filippis, F., Giua, M., Salvatici, L., & Vaquero-Piñeiro, C. (2022). The international trade impacts of Geographical Indications: Hype or hope? Food Policy, 112, 102371.*

[80] *Van Loo, E.J., C. Grebitus, and J. Roosen. 2019. "Explaining attention and choice for origin labeled cheese by means of consumer ethnocentrism." Food Quality and Preference, 78:103716. Slade, P., J.D. Michler, and A. Josephson. 2019. "Foreign Geographical Indications, Consumer Preferences, and the Domestic Market for Cheese." Applied Economic Perspectives and Policy, 41(3):370–390. Caputo, V., G. Sacchi, and A. Lagoudakis. 2018. "Traditional Food Products and Consumer Choices." In Case Studies in the Traditional Food Sector, Elsevier, 47–87.*

A Protected Designation of Origin (PDO) is awarded to products produced, processed, and prepared within a particular geographical area, using recognized know-how. The quality or characteristics of the product should be essentially or exclusively due to the natural environment or the human factors of its place of origin, ensuring that its qualities are unique to that region. By contrast, Products with Protected Geographical Indications (PGI) are closely linked to the geographical area in at least one production stage, processing, or preparation. While not as stringent as PDO, PGI emphasizes a product's quality, reputation, or other characteristics attributed to its geographical origin, ensuring that the product has a specific quality or reputation stemming from that area. By contrast, Traditional Specialty Guaranteed (TSG) labels do not certify that the protected food product has a link to a specific geographical area. Instead, it highlights the traditional composition or means of production. Products bearing the TSG label are recognized for their traditional character, either in the composition or means of production, reflecting traditional methods or recipes. This label aims to protect and promote traditional food products of specific character. These schemes are based on the legal framework provided by the EU Regulation No 1151/2012, which applies within the EU and Northern Ireland. The protection under these schemes is gradually expanded internationally via bilateral agreements between the EU and non-EU countries. This approach ensures that only products genuinely originating in that region can be identified as such in commerce.

Though GIs are less common in the United States, several strategies might be worth exploring. The American Viticultural Area (AVA) system serves a similar purpose to the European Union's Protected Designations of Origin (PDO), Protected Geographical Indications (PGI), and Traditional Specialty Guaranteed (TSG) labels. An AVA is a designated wine-grape-growing region in the United States with recognized geographic or climatic features that distinguish it from surrounding areas and affect the type of grapes grown. This designation helps consumers identify the geographic pedigree of their wines, as wines from a particular area can possess distinctive characteristics due to their unique environment. For a wine to carry an AVA label, at least 85% of the grapes used must be grown within the AVA, and the wine must be fully finished within the state of the AVA. This system, regulated by the Alcohol and Tobacco Tax and Trade Bureau (TTB), emphasizes the importance of terroir in wine production and allows winemakers to highlight the specific qualities of their products derived from their geographical origin.

Vidalia onions offer a prime non-wine example of geographical indication protection within the United States, similar to European Protected Designations of Origin (PDO) and Protected Geographical Indications (PGI). A Vidalia onion is a specific variety of sweet onion grown exclusively in a legally defined production area in Georgia, as established by the "Vidalia Onion Act of 1986" and the United States Code of Federal Regulations (CFR). This act and subsequent federal marketing order limit the production of Vidalia onions to thirteen specified counties and portions of seven others within Georgia. The unique sweetness of Vidalia onions, distinct from other onion varieties, is attributed to the low sulfur content in the soil of the designated growing regions. The protection of the Vidalia onion name under federal law, backed by Georgia's legislation, exemplifies a successful application of geographical indication within the United States, ensuring that only onions grown in the specified areas can be marketed under the Vidalia name.

Creating a geographical indication (GI) for a specialty crop in the mid-Mississippi Delta region involves a strategic approach encompassing legal and agricultural considerations, drawing inspiration from successful models such as the Vidalia onions in Georgia. The first step in this process would be to identify a unique specialty crop that is indigenous or well-suited to the mid-Mississippi Delta region, such as a specific variety of sweet potato, rice, or heritage vegetable that thrives in the region's unique climatic and soil conditions. The uniqueness of the crop could be linked to distinct flavors, textures, or other qualitative attributes that can be directly attributed to the geographical environment of the Delta. Following this, it is essential to conduct comprehensive research to document the historical cultivation practices, the specific geographic area

where these crops are grown, and how the regional terrain influences the crop's qualities. This research would form the basis for defining the specific criteria and standards for what constitutes this specialty crop, akin to how the Vidalia Onion Committee outlines specific varieties and cultivation areas.

The next phase would involve organizing and mobilizing local farmers, agricultural researchers, and regional agricultural agencies to support the initiative. Collaboration is key, as the success of establishing a GI requires consensus and collective action from stakeholders across the agricultural spectrum. This coalition would work together to draft a proposal that outlines the geographic boundaries, the unique qualities of the crop, and the cultivation practices that ensure these qualities. The proposal would then be submitted to relevant state and federal bodies to seek legal protection under a geographical indication or a similar framework. Simultaneously, a marketing and branding strategy should be developed to promote the specialty crop under its new GI, highlighting its unique attributes and the cultural heritage of the mid-Mississippi Delta region. This approach might not only protect the crop's reputation and market but also enhance the economic opportunities for local farmers and contribute to the region's agricultural identity. By following these strategic steps, the mid-Mississippi Delta region can leverage the concept of geographical indications to support sustainable agricultural practices, preserve agricultural heritage, and stimulate local economies.

Tomatoes are one possible commodity that might benefit from a geographic indicator. Heirloom tomatoes could offer a profitable niche for Delta farmers, as these varieties often fetch higher prices than conventional tomatoes. The warm climate of the Delta can support tomato growth, although care must be taken to manage diseases, which can be prevalent in humid conditions. The market for heirloom tomatoes is robust but may require connections with specialty grocers, farmers' markets, or direct-to-consumer sales, as traditional commodity markets may not be suitable. Note the one county with significant vegetable production as a share of agricultural production acreage. Bradley County, Ark., specifically, has a rich history of tomato cultivation. It is known for its annual Pink Tomato Festival, which began in 1956, and the county is recognized statewide for its production of pink tomatoes.

The region's tomato production can be traced back to the 1920s. By the mid-20th century, Bradley County was one of the state's leading producers of tomatoes. The region's success with tomato production is due to a combination of suitable soil, climate, and dedicated growers who have developed the infrastructure for tomato production, which involves individual growers, packing sheds, and distributors. In many cases, growers sell their tomatoes to local packing sheds and then distribute them to retailers. In other cases, growers may sell directly to consumers via farmers markets or roadside stands. However, over the years, the tomato industry in Bradley County, as in many parts of the United States, has faced challenges due to macroeconomic issues in the global market, such as labor issues and regulatory burdens.

Region-Specific Branding

Region-specific branding programs for agri-food products in the United States operate by certifying and promoting agricultural products that are unique to a particular geographical location. These programs, such as Arkansas Grown, aim to promote local agriculture, increase the visibility of regional products, and support local farmers by working with growers and companies producing agricultural goods within the state. Such branding helps distinguish these products in the market and fosters a sense of community and pride among producers and consumers. The primary goals of these programs include promoting local agriculture, improving the marketing skills of roadside farm market operators, enhancing the quality of products sold, and promoting fair and honest marketing practices. By emphasizing the local origin and quality of products, these programs encourage consumers to support their local economies through their purchasing choices, thereby increasing demand for locally-grown produce and potentially boosting sales for farmers within the region.

These approaches can be generic or product-specific. For example, Louisiana-based Jazzmen Rice represents an example of a product-specific campaign for regionally unique aromatic rice. The brand's development started in 2009 and aimed to create a locally grown product that could compete with imported jasmine rice varieties. The business model of Jazzmen Rice requires cultivating, processing, and selling aromatic rice that was bred specifically to thrive in the climate and soils of Louisiana.[81] Critical collaborators included local Louisiana farmers, Louisiana State University, and the Louisiana Department of Agriculture and Forestry.[82] The rice is grown exclusively by local farmers and then processed and packaged for sale under the Jazzmen Rice brand. This approach leverages the appeal of a locally grown, high-quality product to carve out a niche in the rice market, competing not on price but on unique attributes such as taste and aroma and a connection to local agriculture and culture.

While specific examples of interstate or multi-state region-specific branding programs for agri-food products in the United States are not as common as state-specific programs, the concept does exist in various forms, particularly through initiatives that transcend state boundaries to promote agricultural products distinctive to a larger geographical region. For instance, programs like the Appalachian Grown certification aim to support local economies in the Appalachian region by certifying products grown or raised in multiple states within that area, enhancing their market visibility. Similarly, the Chesapeake Bay region has seen efforts to brand and promote seafood and other agricultural products unique to its watershed, which spans several states.

These region-specific branding programs establish a unified identity for products from a broader geographical area, leveraging the region's unique environmental and cultural characteristics to differentiate their products.[83] By doing so, they help preserve the region's agricultural heritage and open up new marketing opportunities for farmers and producers within that area. Such programs require collaboration across state lines, involving various stakeholders, including state agricultural departments, regional development agencies, and industry groups, to develop standards, certification processes, and marketing strategies that reflect the collective interests and strengths of the region.[84] Through these efforts, region-specific branding programs can significantly contribute to the sustainability and growth of local and regional agri-food systems, enhancing the competitiveness of specialty crops on a national and even global scale.

[81] *Benedict, L. (2011). Jazzman competes well in aromatic rice market. LSU AgCenter. https://www.lsuagcenter.com/portals/communications/publications/agmag/archive/2011/summer/jazzman-competes-well-in-aromatic-rice-market.*

[82] *Sha, X.Y., Linscombe, S.D., Jodari, F., Chu, Q.R., Groth, D.E., Blanche, S.B., Harrell, D.L., White, L.M., Oard, J.H., Chen, M.H. and Theunissen, S.J., 2011. Registration of 'Jazzman' aromatic long-grain rice. Journal of Plant Registrations, 5(3): 304-308.*

[83] *Moreno, F., & Malone, T. (2021). The role of collective food identity in local food demand. Agricultural & Resource Economics Review, 50(1), 22-42.*

[84] *Neill, C. L., Holcomb, R. B., & Lusk, J. L. (2020). Estimating potential beggar-thy-neighbor effects of state labeling programs. Agribusiness, 36(1), 3-19.*

Part III - Unintended Consequences and Possible Mitigation Strategies

The dynamic landscape of agriculture is increasingly embracing value-added products and specialty crops, driven by consumer demand for diverse, sustainable, and locally sourced food options. This shift presents an exciting frontier for agricultural innovation and economic growth, particularly in regions poised to diversify their agricultural portfolio. However, the journey towards transforming agriculture into a more value-added sector is fraught with complexities and potential unintended consequences that require careful consideration and strategic planning to foster long-term sustainability and equitable growth.

Akin to any opportunity for transforming the agri-food system, decision-makers must carefully consider their approach to this expansion, as research and history suggest that policymakers must avoid a centrally planned approach. Even in the best cases, where specialty crops earn higher prices than their row crop counterparts, they also come with higher variable and fixed production costs due to the need for more intensive management, specialized equipment, and higher labor input. Furthermore, specialty crops require significant post-harvest handling (processing, packaging), necessitating infrastructure not readily available in the region.[85] In the context of the Mississippi Delta, soil types, climate conditions, and farmer skills and preferences can vary significantly across the region. Attempting any centrally planned model for specialty crop expansion in the Delta could spell catastrophic risk for producers operating on razor-thin margins, leading to poor crop choices, low yields, and economic losses. This risk is especially true given the data constraints surrounding specialty crop production and marketing in the Delta. Indeed, a lack of data creates extreme uncertainty surrounding any recommendations that might be made to "move" California production systems to the region.

Instead, a market-driven, farmer-centric, decentralized strategy may prove more effective. Creating institutional frameworks where decisions are made by individual farmers based on their knowledge and market signals generally results in more efficient and sustainable outcomes. This approach allows farmers to choose the specialty crops most suited to their unique circumstances, enhancing the chances of successful production. For example, a farmer with sandy soil might opt for sweet potatoes, while another with clay soil might prefer specialty rice. Similarly, a farmer with a local farmers market might choose different crops than one primarily selling to restaurants or supermarkets.

When implementing programs to increase opportunities for specialty crop production in regions like the Mid-Mississippi Delta, several unintended consequences may arise. Identifying these potential issues and evaluating mitigation strategies is crucial for the success and sustainability of such initiatives. Among these challenges are market saturation, resource strain, environmental impact, and cultural and social impacts, each posing unique risks to the viability of specialty crop production and value-added processing. Addressing these issues demands a multifaceted approach that identifies potential pitfalls and devises robust mitigation strategies. From diversification and support networks to market research, education, financial planning, and risk management, these strategies aim to build a resilient agricultural sector that can adapt to changing market demands, facilitate sustainable resource use, and maintain farming communities' cultural and social fabric. As we delve deeper into these unintended consequences and explore effective mitigation strategies, it becomes clear that the success of the value-added agricultural sector hinges on a collaborative effort among producers, policymakers, and support organizations to foster an environment that encourages innovation while safeguarding against potential downsides.

[85] *Paciarotti, Claudia, and Francesco Torregiani. (2021) "The logistics of the short food supply chain: A literature review." Sustainable Production and Consumption 26: 428-442.*

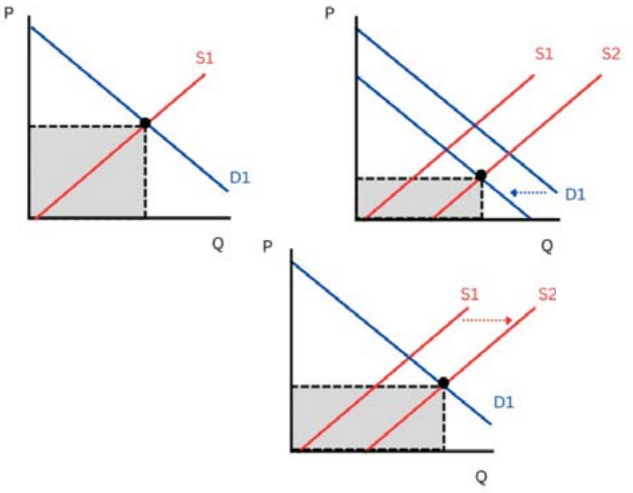
Market Saturation

As more producers begin to process and market similar value-added products, there is a risk of market saturation. This can lead to reduced prices and profits for producers, particularly if the increase in supply outpaces demand growth. Market saturation emerges as a significant unintended consequence when the agricultural sector shifts towards the increased production of value-added and specialty crops. As more producers pivot to these high-value products, driven by the potential for higher margins and market demand, the initial advantage of niche market positioning may diminish. The uniqueness that commands premium pricing can erode if the market is flooded with similar products, leading to an imbalance between supply and demand. This saturation forces prices downwards, squeezing profit margins, potentially destabilizing the economic sustainability of the producers who have invested in transitioning to these crops.

The risk of market saturation is particularly pronounced in regions where the agricultural sector lacks diversity in value-added product offerings. When multiple producers concurrently enter the market with similar product types without a corresponding increase in consumer demand or market expansion strategies, the result can be an increase in supply. This glut can lead to intense competition among producers for market share, which might result in a race to the bottom in pricing. Small-scale and medium-scale producers, who may not have the same marketing and distribution capabilities as larger entities, are especially vulnerable in such a scenario. Their narrower profit margins make them unable to withstand prolonged periods of low prices, leading to potential financial strain or business failure.

Figure 15B presents a conceptual framework for the dynamic development of specialty crop and value-added food markets as entrepreneurs expand their production in a novel region. The first panel demonstrates the current equilibrium of a specialty crop market without any increased supply from new cultivation. In that market scenario, we can define the total addressable market (TAM) for the specialty crop market as the product of the equilibrium price and quantity.

FIGURE 15B: CONCEPTUAL FRAMEWORK OF EXPANDING SPECIALTY CROPS WITHOUT A FULL UNDERSTANDING OF THE MARKET



Given the limitations on currently-produced specialty crops in the region, the relatively high equilibrium price might attract agri-food entrepreneurs, as specialty crop production systems are limited in a way that commodity crops are not; if agricultural producers project increased demand for a traditional agricultural commodity, they can plant more during the proceeding growing season. With increasing consumer demand, producers may even invest in technology and practices to increase their yield. If an external support organization subsidized a commercialized production process, it would relax constraints on the supply curve. Figure 15B introduces this additional specialty crop cultivation, shifting the supply curve to the right. The added supply expands the equilibrium quantity demanded from Q1 to Q'1 while the equilibrium market price will likely decline from P1 to P'1. Thus, the first practical inference from our simple conceptual framework is that increasing production of specialty crops in a new region shifts product supply to the right, reducing the expected equilibrium price an entrepreneur might expect. This reduction in price can often be disastrous for an upstart niche agricultural market, though the extent of the change in the size of the total addressable market is a function of the slope of the demand curve. The extent to which this increase in supply changes an entrepreneur's total addressable market can be stated as:

$$\%\Delta\, Total\ Addressable\ Market = \frac{\left(P'_1 \times Q'_1\right) - \left(P_1 \times Q_1\right)}{\left(P_1 \times Q_1\right)}.$$

The second panel of the figure assumes that consumers consider specialty crops from the Delta to be the same product, where the added production shifted the pre-existing supply curve. In other words, this assumption implies that an agri-food entrepreneur who chooses to grow food in the Delta will capture more of the current specialty crop market to offset the lowered equilibrium price; i.e., the quality is the same. That said, prior sections of the manuscript indicate that some U.S. consumers value Delta-grown products less, indicating a negative "credence attribute." These attributes contrast with "search attributes" like color, price, or size, which consumers can determine before purchase, and "experience attributes" like taste or texture, which can be assessed after purchase but before consumption. Examples of credence attributes can include a food's organic status, carbon footprint, fair trade certification, animal welfare standards, or, in this case, a product's location of origin. The final panel of the figure demonstrates the updated TAM for an agri-food entrepreneur who expands specialty crop production after we adjust the extent of the market to a decline in demand due to "Delta-grown" as a negative credence attribute:

$$\%\Delta\, Total\ Addressable\ Market^{*} = \frac{\left(P_{Overall} \times Q_{Overall}\right) - \left(P'_1 \times Q'_1\right)}{\left(P'_1 \times Q'_1\right)}.$$

As such, the total addressable market for an agri-food entrepreneur interested in these markets is not only a function of supply but also hinges on consumer demand. We might expect views on alternative food systems and politics to be consumer characteristics that influence that demand. We also expect views about alternative food systems to be tied to beliefs about nutrition, taste, and healthiness. We expect that premiums for Delta-grown foods are associated with ecological and ethical considerations. Indeed, previous literature has stated that food purchasing patterns are political in that consumers are "voting with your dollar" for food systems that literally or symbolically align with their values.[86]

Mitigation Strategies

Mitigation strategies to prevent market saturation involve careful market analysis, strategic planning, and coordinated efforts among producers. Diversifying product offerings, identifying and targeting niche markets, and creating unique value propositions are essential steps in avoiding direct competition and maintaining product distinctiveness. Additionally, fostering collaboration among producers to manage supply and align it more closely with market demand can help stabilize prices and promote a fair return on investment. Furthermore, expanding market access through innovative marketing and distribution channels, such as direct-to-consumer sales, online marketplaces, and regional branding initiatives, can open new demand avenues. Education and outreach efforts that promote the benefits and unique qualities of value-added and specialty crops can also stimulate consumer interest and demand.

Diversification stands as a robust strategy for producers aiming to mitigate the risks associated with market saturation. By broadening their portfolio to include various value-added products, producers can shield themselves from the volatility of relying on a singular market or product line. By increasing the number of products offered and strategically selecting offerings that cater to different market segments or needs, diversification ensures that if one product faces a decline in demand due to market saturation, the overall business environment remains relatively stable. Moreover, diversification can enhance a producer's resilience against economic downturns, allowing for the reallocation of resources to more profitable areas when necessary.

Exploring niche markets and focusing on unique product differentiation are pivotal elements of an effective diversification strategy. Niche markets offer the advantage of targeted consumer bases often willing to pay a premium for products that specifically cater to their unique needs or preferences. Producers can secure a loyal customer base by identifying and penetrating these markets and reducing competition,

[86] *Biedny, C., Malone, T., & Lusk, J.L. (2020). Exploring polarization in U.S. food policy opinions. Applied Economic Perspectives & Policy, 42(3), 434–454. Malone, T., & Norwood, F.B. (2020). Gluten aversion is not limited to the political left. Agriculture & Human Values, 37(1), 1–15.*

thus generating more stable revenue streams. Product differentiation, conversely, involves creating products that stand out from competitors through unique features, quality, or branding. This attracts attention in crowded markets and builds a strong brand identity that can command higher prices and foster customer loyalty. These strategies enable producers to tap into new opportunities and maintain a competitive edge even as markets evolve.

Resource Strain

Specialty crop production systems and value-added processing require additional resources, including equipment, labor, and expertise. Small-scale producers might struggle to access or afford these resources, potentially widening the gap between small and large producers. The shift towards value-added agricultural production, while promising economic benefits and market differentiation, brings with it the challenge of resource strain. This challenge is particularly acute for small-scale producers, who may be disadvantaged as the increased demand will likely raise prices for resources such as specialized equipment, labor, and expertise necessary for processing and adding value to raw agricultural products. The requirement for these additional resources can create a significant barrier to entry for smaller producers, potentially exacerbating the disparities between small and large-scale operations in the agricultural sector.

Small-scale producers, who often operate with limited capital and lower economies of scale, might struggle to invest in the necessary infrastructure for value-added processing and specialty crop production. The financial outlay for equipment and technology to process crops and the need for skilled labor capable of managing these processes can be prohibitive. This resource strain limits their ability to diversify and increase the value of their products and risks widening the economic gap between them and their larger counterparts. Large producers, with more substantial financial resources and access to capital, can more readily absorb these costs, allowing them to capitalize on the value-added market's opportunities and potentially dominate these niches.

Mitigation Strategies

Mitigating the impact of resource strain requires targeted support and innovative solutions to level the playing field for small-scale producers. Financial incentives, such as grants, low-interest loans, and investment in shared processing facilities, can alleviate some initial capital burdens, along with the investment in market research and training for producers. These shared facilities (i.e., incubators or co-processing centers) allow multiple producers to access processing equipment and expertise without bearing the full cost individually. Additionally, extension services and educational programs tailored to the needs of small-scale producers can enhance their knowledge and skills in value-added processing, improving their competitiveness and capacity to participate in these markets.

Collaboration and cooperative models present another strategic approach to mitigating resource strain. By banding together, small-scale producers can pool resources, share knowledge, and collectively invest in processing capabilities. This cooperative approach reduces individual investment and operational costs and strengthens market presence and bargaining power. Through these concerted efforts and support mechanisms, the agricultural sector can foster a more inclusive environment for value-added production, providing small-scale producers the resources and opportunities to thrive alongside their larger counterparts and promoting economic resilience and sustainability.

Providing producers with comprehensive market research, education, and training on changing consumer preferences and market trends is a pivotal strategy for mitigating economic dependency and enhancing the resilience of specialty crop production. Increasing market research and education makes producers more aware of the current market dynamics, equipping them with the knowledge and skills needed to adapt and innovate in response to evolving market needs. Through targeted education programs, producers can gain insights into consumer behavior, emerging trends, and potential niche markets, enabling them to make informed decisions about crop selection, value-added product development, and marketing strategies. This knowledge base is crucial for staying competitive and relevant in a rapidly changing market environment.

Continuous education and training programs help build a culture of innovation and adaptability among producers, encouraging them to explore new processing techniques, sustainable practices, and product diversification. By understanding the market's direction, producers can proactively adjust their business models to meet consumer demands, thus reducing the risk of economic vulnerability caused by market saturation or shifts in consumer preferences. This strategic approach supports the financial sustainability of producers and contributes to the overall growth and diversification of the specialty crop sector. Educating producers about the importance of market research and consumer trends is essential for fostering a dynamic and resilient agricultural community that can navigate the challenges and opportunities of the global market.

Offering workshops and resources on financial planning and risk management can help producers navigate the uncertainties associated with value-added production, including fluctuating market demands and policy changes. These workshops can introduce producers to essential financial concepts and tools, enabling them to create robust business plans, budget effectively, and manage cash flow. They can also cover strategies for mitigating financial risk, such as diversification of product lines, securing contracts in advance, and leveraging insurance options.

Furthermore, understanding the financial landscape can also empower producers to make informed decisions about investments in value-added processes and new crop varieties. By incorporating risk management strategies, such as futures contracts, options trading, and hedging, producers can protect themselves against price volatility and unfavorable market conditions. Financial planning and risk management education can also include guidance on accessing credit and grants, which are crucial for funding the initial setup and ongoing operations of value-added ventures.

Environmental Impact

Because of the reduced economies of scale, increased production and processing of small-scale specialty crop production systems might lead to higher energy consumption, waste, and greenhouse gas emissions. This might counteract the sustainability goals of specialty crop production. Implementing sustainable practices in value-added processing and specialty crop production, such as using renewable energy sources, minimizing waste, and promoting recycling, can help mitigate environmental impacts.

Pursuing value-added agriculture and increased specialty crop production, while holding significant economic promise, poses potential environmental challenges. The intensification of production and processing activities associated with these ventures can lead to an uptick in energy consumption, waste generation, and greenhouse gas emissions. This escalation in environmental footprint can risk undermining the sustainability objectives that often motivate the shift towards specialty crops and value-added products. Such objectives typically include economic development and the promotion of ecological balance and resource conservation.

Mitigation Strategies

Addressing these environmental impacts necessitates consciously and strategically incorporating sustainable practices throughout the production and processing chain. This includes leveraging renewable energy sources to power operations, reducing reliance on fossil fuels, and lowering carbon emissions. Moreover, optimizing production processes to minimize waste generation and implementing comprehensive recycling programs can significantly mitigate the environmental consequences of expanded value-added activities. These practices contribute to environmental sustainability and enhance the market appeal of the final products to increasingly eco-conscious consumers.

Adopting sustainable agricultural practices, such as precision farming and integrated pest management, can further diminish the environmental impacts of specialty crop production. These practices aim to maximize efficiency in resource use, reduce chemical inputs, and promote biodiversity, thereby ensuring that increased production does not come at the cost of ecological health. Life cycle assessments

can also identify and address the most significant environmental impacts across the value chain, from cultivation to processing and distribution, enabling producers to make informed decisions that align with economic and environmental objectives.[87]

To successfully integrate these environmental considerations into expanding value-added and specialty crop production, support from policy, research, and industry is crucial. Policy incentives for adopting green technologies, research into more efficient and sustainable production methods, and industry commitments to environmental stewardship can collectively foster a conducive environment for achieving the dual goals of economic development and environmental sustainability.

Cultural and Social Impacts

The push towards value-added products and specialty crops could inadvertently devalue traditional farming practices and products, leading to a loss of cultural heritage and affecting the social fabric of farming communities. Programs can include initiatives that encourage preserving and promoting traditional and culturally significant crops and processing methods. This can help maintain cultural heritage and support community cohesion.

The movement toward value-added products and specialty crops presents opportunities and challenges, with cultural and social impacts being a significant concern. As the agricultural sector shifts focus towards more commercially viable and globally marketable produce, there's a tangible risk of marginalizing traditional farming practices that have been the backbone of rural communities for generations. Often passed down through families, these practices embody agricultural techniques, cultural values, and social structures. The erosion of such traditions can lead to a loss of cultural heritage, impacting the identity and cohesion of these communities.

Moreover, this shift can exacerbate the divide between small-scale farmers and large agribusinesses. Small farms, which are less able to invest in the necessary infrastructure for value-added production, may find their products and practices deemed less relevant or economically viable. This can lead to a socioeconomic stratification within rural areas, where the benefits of the agricultural shift accrue to a select few, leaving behind those unable to adapt. Such a scenario could undermine community solidarity and exacerbate rural poverty as traditional livelihoods become unsustainable.

To mitigate these cultural and social impacts, it is crucial to develop and implement programs that recognize and value cultural heritage and community integrity. Initiatives could include support for small-scale farmers to diversify into value-added products rooted in traditional practices, financial and technical assistance to preserve indigenous crops, and marketing strategies highlighting the cultural significance of these products.

Furthermore, engaging community members in the planning and implementing process is essential. This inclusive approach allows for projects to resonate with the community's values and needs, fostering a sense of ownership and pride in the outcomes. It also opens avenues for intergenerational knowledge transfer, enabling traditional practices to be preserved and adapted to meet contemporary needs. By balancing innovation with tradition, creating a more sustainable and equitable agricultural sector that supports economic development and cultural preservation is possible.

A core mitigation strategy to maintaining cultural and social cohesion during a transition to specialty crop production systems is to be sure that the new cropping systems are consistent with the social identity of the region. The word clouds below come from responses to a survey distributed via Qualtrics to 1,000 U.S. food consumers in October 2023. Participation was limited to respondents in the mid-Delta states (Missouri, Arkansas, Tennessee, Mississippi, and Louisiana). We asked three open-ended questions to identify unique layers within the lexicon of consumer demand for locally and regionally produced foods. Each word cloud is restricted to the top 75 words most mentioned.

FIGURE 16B: MANY PEOPLE BELIEVE THEIR STATE IS ASSOCIATED WITH GROWING OR RAISING A PARTICULAR TYPE OF FOOD

In the space below, please list one or more foods that you believe is most associated with the state in which you currently reside.

Instead of starting with a question about the Mississippi Delta region, Figure 16B asks people about what their state is known for producing. This is consistent with the literature and provides a baseline for each participant's thoughts about local foods. Most consumers in this region connected their state with their state's largest commodity crops, including corn, soybeans, rice, and chicken. The top specialty crops mentioned by the sample included watermelons, strawberries, and tomatoes. Of note is the number of participants who mentioned fish and seafood as being a part of their state's cultural identity.

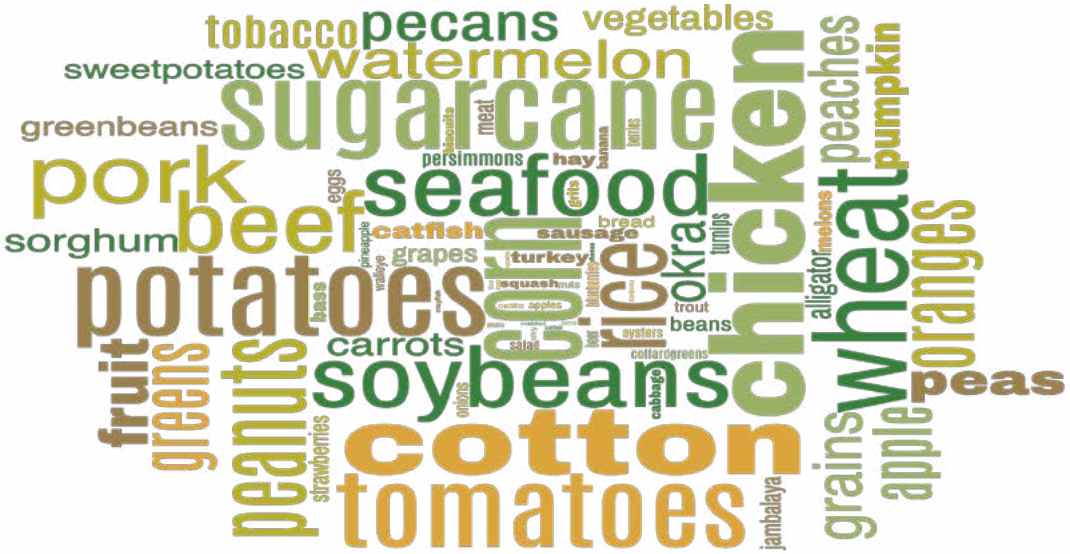
By contrast, Figure 17B shifts its attention to regional attachments to agri-food products in the community. Again, corn, soybeans, rice, and chicken were some of the most identified agri-food products. "I don't know" became a more popular answer in this segment, increasing from 10 participants in the state-level question to 42 participants in the regional question. In general, fewer specialty crop options were identified in this question than were identified in the state-level question, indicating a shift in the lexicon around food from the Mississippi Delta region and local food systems from states that are within those mid-Delta states. Fish and seafood remained on the list as items that are identified with the region. Sweet potatoes, watermelons, and tomatoes were still listed, though to a lesser extent than in the prior question.

FIGURE 17B: MANY PEOPLE BELIEVE THEIR REGION IS ASSOCIATED WITH GROWING OR RAISING A PARTICULAR TYPE OF FOOD

In the space below, please list one or more foods that you believe is most associated with the Mississippi River Delta Region.

In contrast to states in the population-dense coastal states, the mid-Delta states are not very population dense; the combined population density of Mississippi, Arkansas, Louisiana, Tennessee, and Missouri is approximately 90 people per square mile.[88] Even though the mid-Delta region does not share the same population density as coastal states such as California, promoting local and regional food demand can create an important first step toward revitalizing the technical knowledge and developing supply chains necessary for specialty crop production in the area. Figure 18B presents what food products participants wish were grown and raised in the region. While 36 participants still indicated that they did not know enough to have an opinion, a much larger percentage of participants indicated that they would like to see more fruits and vegetables grown in the region. This indicates some level of appetite for additional specialty crop production from the states in the region, which include a population of approximately 24 million. (For context, the population of California is approximately 39 million.)

FIGURE 18B: WHAT FOOD PRODUCTS DO YOU WISH WERE GROWN/RAISED MORE IN THE MISSISSIPPI RIVER DELTA REGION?



Cultivating Support Networks

Developing robust support networks and shared resource centers emerges as a strategic solution to alleviate the challenges of resource strain faced by small-scale producers within the specialty crop sector. These networks serve as a crucial foundation, offering a collective platform where producers can access shared processing facilities, critical expertise, and vital marketing resources. By pooling resources, small-scale producers can significantly reduce the individual financial and operational burdens associated with acquiring and maintaining high-cost processing equipment and facilities. This collaborative approach enhances their production capabilities and fosters a community of practice that facilitates knowledge exchange and innovation, enabling producers to navigate the complexities of the market more effectively.[89]

Moreover, these support networks can play a pivotal role in leveling the playing field between small and large producers. By granting smaller operators access to similar quality resources as their larger counterparts, these networks can help mitigate the disparities in production efficiency and market access. This democratization of resources encourages a more diverse and competitive marketplace where unique and high-quality value-added products can thrive. Support networks, through shared resource centers, address the immediate resource constraints faced by small-scale producers and contribute to the long-term sustainability and resilience of the specialty crop industry.

[88] *The population density of Arkansas is 58 people per square mile, Tennessee is 171 people per square mile, Louisiana is 87 people per square mile, Mississippi is 61 people per square mile, and Missouri is 89 people per square mile, and California has a population density of 238 people per square mile.*

[89] *Sabatier, P. A., Focht, W., Lubell, M., Trachtenberg, Z., Vedlitz, A., & Matlock, M. (2005). Swimming Upstream: Collaborative Approaches to Watershed Management.*

Conclusion

By anticipating these unintended consequences and implementing specific mitigation strategies, support service providers might more effectively assist specialty crop producers, contributing to the economic development of regions like the Mid-Mississippi Delta while promoting sustainable and resilient agricultural practices. In addition to these areas for exploration, we have two additional recommendations for this project. First, we recommend a grassroots strategy that promotes and propagates the entrepreneurial decisions that have already been made in the Mississippi Delta by Delta growers. The lack of clarity in consumer responses regarding Delta agri-food products indicates a critical need for additional regional branding that might elevate these products in the purview of producers in the region. As an extension, we recommend a name change for the remainder of the project, as the physiological needs associated with crop selection make the name inconsistent with the likely project outcomes. Alternative naming options might focus on the comparative advantages provided by this critical agricultural region. More appropriate options might be "Delta Roots," "Delta Seeds," "Delta Grown," or "Delta Made." We also plan to conduct a follow-up survey of U.S. consumers to explore whether there are crops considered to be a part of the collective food identity of the Mississippi Delta, as a shift toward "consumer-pull" production decisions rooted in customer discovery can sometimes identify additional market opportunities.[90]

Regardless of the crop selection, the Delta remains constrained by labor shortages and infrastructure gaps. Unlike row crops, which are often grown using mechanized equipment, specialty crops are typically grown using manual labor techniques such as hand planting and harvesting. Specialty crop production often follows a different seasonal pattern than traditional crops, which may lead to a need for unique year-round specialized labor. The manual labor requirements for planting, harvesting, and handling specialty crops can be significantly greater than for traditional crops that use mechanized processes. This shift could create more jobs in the region but also presents labor availability and cost challenges.[91]

[90] *Moreno, F. and Malone, T., 2021. The role of collective food identity in local food demand. Agricultural and Resource Economics Review, 50(1):22-42.*

[91] *Charlton, D., Rutledge, Z. and Taylor, J.E., 2021. Evolving agricultural labor markets. In Handbook of Agricultural Economics (Vol. 5: 4075-4133). Elsevier.*

Part IV - Economic Opportunities and Hurdles Facing Farmers, Businesses, and Local Communities in The Mid-Mississippi River Delta

The final section of this report investigates the potential for increasing specialty crop production in the Mississippi Delta as increased regulatory pressures and escalating agricultural land prices in California could make the Mississippi Delta more appealing to farmers and investors. Nonetheless, transitioning towards specialty crop cultivation in the Delta demands caution due to the increased production costs, intensive management, and the need for post-harvest infrastructure, which may not be readily available in the region. Moreover, the diverse soil types, climate conditions, and farmer preferences in the Delta pose further challenges to specialty crop expansion. Therefore, a decentralized, farmer-centric strategy is recommended, enabling farmers to select crops best suited to their circumstances. The study suggests the potential for specialty rice, soybeans, and corn crops. Though the Mississippi Delta region's unique characteristics pose challenges to the development of fruit production, the potential might lie in certain crops, including blueberries, peaches, muscadine grapes, specialty melons, and blackberries. Key vegetables grown in the region include tomatoes, sweet potatoes, okra, peas, and pumpkins. Other potential specialty crops include pecans, peanuts, and ornamental crops. Supporting this transition to specialty crop production would require significant investments in agricultural research and extension services, infrastructure improvements, favorable policies, and facilitating the creation of farmer cooperatives and associations.

There is potential for expanded specialty crop production in the Mississippi Delta as the California agricultural system faces considerable headwinds. California has been experiencing increased regulatory pressures related to water usage, labor, and environmental concerns. For instance, the Sustainable Groundwater Management Act requires local agencies to balance their groundwater demand and supply by 2040, which could significantly impact irrigation-dependent agriculture.[92] Additionally, rising labor costs due to increased minimum wage and new labor laws can make farming in California more expensive.[93] Further, California's stringent pesticide and herbicide regulations present challenges for producers. The California Department of Pesticide Regulation imposes rigorous rules on the use of various chemical substances in agriculture, and these rules have been tightening over the years.[94] These regulatory pressures might incentivize specialty crop producers to consider regions like the Mississippi Delta, where pesticide and herbicide regulations may be less stringent. Of course, any use of these substances would still need to adhere to federal regulations and be managed responsibly to protect local ecosystems and water resources. However, the prospect of a lower regulatory burden might appeal to producers.

Furthermore, California's agricultural land prices have increased significantly in value. The average cost per acre of farm real estate in California was $12,000 in 2021, a 28% increase from $9,350 in 2018.[95] In comparison, the average cost per acre of farm real estate in the Delta States (Arkansas, Louisiana, and Mississippi) was $3,340 in 2021, up 11% from $3,000 in 2018. This further divergence in land prices could motivate farmers and investors to explore agricultural opportunities in other regions, such as the Mississippi Delta, where land prices are more affordable.

Akin to any opportunity for transforming the agri-food system, decision-makers must carefully consider their approach to this expansion, as research and history suggest that policymakers must avoid a centrally planned approach. Even in the best cases, where specialty crops earn higher prices than their row crop counterparts, they also come with higher variable and fixed production costs due to the need for more intensive management, specialized equipment, and

[92] *DiMento, Joseph FC. "The Shape of Groundwater Law: California's New Sustainability Act." Journal of the Southwest 59.1/2 (2017): 364-393.*

[93] *Martin, Philip. "Immigration and farm labor: challenges and opportunities." (2017). Giannini Foundation Information Series. 017-1.*

[94] *Malloy, T., J. Froines, A. Hricko, K. Vasquez, and M. Gamble. 2019. "Governance on the Ground: Evaluating the Role of County Agricultural Commissioners in Reducing Toxic Pesticide Exposures." Emmett Institute on Climate Change and the Environment. Retrieved from: https://law.ucla.edu/news/governance-ground-evaluating-role-county-agricultural-commissioners-reducing-toxic-pesticide.*

[95] *"Land Values 2022 Summary," USDA Economic Research Service, 2022. Retrieved from https://www.nass.usda.gov/Publications/Todays_Reports/reports/land0822.pdf.*

higher labor input. Furthermore, specialty crops require significant post-harvest handling (processing, packaging), necessitating infrastructure not readily available in the region.[96] In the context of the Mississippi Delta, soil types, climate conditions, and farmer skills and preferences can vary significantly across the region. Attempting any centrally planned model for specialty crop expansion in the Delta could spell catastrophic risk for producers operating on razor-thin margins, leading to poor crop choices, low yields, and economic losses. This risk is especially true given the data constraints surrounding specialty crop production and marketing in the Delta. Indeed, a lack of data creates extreme uncertainty surrounding any recommendations that might be made to "move" California production systems to the region.

Instead, a market-driven, farmer-centric, decentralized strategy may prove more effective. Creating institutional frameworks where decisions are made by individual farmers based on their knowledge and market signals generally results in more efficient and sustainable outcomes. This approach allows farmers to choose the specialty crops most suited to their unique circumstances, enhancing the chances of successful production. For example, a farmer with sandy soil might opt for sweet potatoes, while another with clay soil might prefer specialty rice. Similarly, a farmer with a local farmers market might choose different crops than one primarily selling to restaurants or supermarkets.

Following that spirit, this report provides specialty crops that might be considered possibilities in the region, along with potential issues to be considered. After a thorough review of the literature and currently available data, our best recommendation is to focus on the crops that already show some evidence of success in the region. This list should be considered a starting point for conversation, as more research is required to reduce the uncertainty associated with selecting these crops.

Current Agricultural Production in the Delta

Markets tend to work toward an equilibrium price and quantity. That is, the current agricultural production in the Mississippi Delta represents a confluence of attributes about the region which are all likely to play a role in developing some level of economic path dependency. Despite its rich soil and abundant water supply, the Mississippi Delta is not a significant producer of specialty crops. One of the primary reasons for this lack of specialty crop production is the historical success of large-scale commercial agriculture, particularly row crops such as soybeans and rice.[97] These crops are well-suited to the Delta's climate and soil and have long been a staple of the region's agriculture. Producers will likely continue to grow these options at a large commercial scale due to their market demand, established infrastructure for processing and marketing, and available government insurance programs. They also require significant fertilizer and pesticide inputs, which can cause drift issues, further challenging the transition to more diversified crop rotations, including specialty crops.

The Mississippi Delta faces environmental challenges that may make growing specialty crops more difficult and require substantial investment into their land grant support systems. This is especially true as the high humidity encourages the proliferation of pests and diseases, necessitating more intensive pest and disease management. Due to this added pest pressure, organic agriculture will likely prove difficult in the Delta as high margins from organic price premiums will likely be out of reach. For example, the region is known for its high populations of root-knot nematodes, which can be a major problem for some crops.[98] Effective pest and disease management practices will be essential for the success of emerging crops in this region.

[96] *Paciarotti, Claudia, and Francesco Torregiani. (2021) "The logistics of the short food supply chain: A literature review." Sustainable Production and Consumption 26: 428-442.*

[97] *Hudson, John C., and Christopher R. Laingen. American Farms, American Food: A Geography of Agriculture and Food Production in the United States. Lexington Books, 2016.*

[98] *Faske, T. R., Mueller, J. D., Becker, J. O., Bernard, E., Bradley, C. A., Bond, J. P., ... & Zhang, L. (2023). Summarized distribution of the southern root-knot nematode, Meloidogyne incognita, in field crops in the United States. Plant Health Progress.*

Soil Differences

Fruits, vegetables, tree nuts, dried fruits, and nursery crops require specific soil conditions for optimal growth and may require specialized soil management practices, such as drainage systems or amendments, to thrive.[99] Other possible mitigation strategies include investing in soil health management programs, such as crop rotation and cover crops, and providing resources and incentives for farmers to adopt sustainable farming practices. Because the Mississippi Delta is an alluvial plain, its soil is largely formed in sediment deposits from the Mississippi River over thousands of years. These soils are predominantly silty clay and silty loams, with good water-holding capacity.[100] The Delta's clay-like soils are also prone to compaction and poor drainage. They can become waterlogged, leading to oxygen deprivation for plant roots, soil nitrogen loss, and lower crop production.[101] Waterlogging is especially damaging during high rainfall periods. Though the Delta soil's nutrient richness and plant-available water make it suitable for growing cotton, soybeans, and rice, among other crops, some locations have high clay that may limit the growth of specialty crops like fruits, vegetables, and nuts, which require well-drained soils to prevent root diseases. Although modifications such as artificial drainage can overcome this limitation, they introduce additional costs to the cultivation process. That said, many of the soils in the Delta are loamy ranging from sandy loams to silt loams. A core issue is that they have higher clay in the subsurface and many soils have a fragipan (a weakly cemented subsurface horizon that restricts water flow). With the low relief and the restricted downward water flow, the soil will have seasonal water table that approaches the surface which limits trafficability, increases compaction potential, and causes root disease issues and anoxic conditions. If the soil in California got the same rainfall as the Delta, producers in the state would likely have similar problems. That said, Californians have fertile soils that allow for simpler water management, whereas the Mississippi Delta region cannot manage the water without significant environmental engineering investments such as tile drains or surface water diversion.[102]

Indeed, these issues contrast the alluvial deposits forming the California Central Valley soils, which are primarily well-drained and aerated, favoring root development. The California Central Valley is known for its high organic matter content and exceptional fertility. Its high concentrations of crucial nutrients, including potassium, calcium, and magnesium, benefit specialty crops' nutrition. These conditions support a diverse agricultural landscape, producing over 230 crops such as almonds, grapes, peaches, and strawberries. Unlike in the Mississippi Delta, the loamy and well-drained soils allow specialty crops to thrive without risking water-logging-related diseases. In addition, the Central Valley's soil has a high cation-exchange capacity, enabling it to retain and supply nutrients to plants effectively. However, the extensive cultivation and irrigation in this region has led to problems like soil salinization and nutrient leaching, which can negatively affect crop productivity if not properly managed.

The differences in soil characteristics between these two regions have critical implications for specialty crop production. While both regions have fertile soils capable of supporting vigorous agricultural activities, the soil characteristics of the California Central Valley offer a more conducive environment for specialty crop production than the Mississippi Delta. The Mississippi Delta's high water-holding capacity soils can support crops that require significant moisture, such as rice and soybeans. However, the region's frequent flood risks and the soil's tendency to compact may limit the range of specialty crops that can be cultivated effectively.[103] By comparison, the well-draining soils of the California Central Valley are conducive to a wide range of specialty crops, including grapes, almonds, and various fruit trees, which require good drainage and aeration.[104]

[99] *Bengtson, R. L., Carter, C. E., Fouss, J. L., Southwick, L. M., & Willis, G. H. (1995). Agricultural drainage and water quality in Mississippi Delta. Journal of Irrigation and Drainage Engineering, 121(4): 292-295.*

[100] *Schaetzl, R., & Anderson, S. (2005). Soils: Genesis and Geomorphology. Cambridge University Press.*

[101] *Kaur, G., Singh, G., Motavalli, P. P., Nelson, K. A., Orlowski, J. M., & Golden, B. R. (2020). Impacts and management strategies for crop production in waterlogged or flooded soils: A review. Agronomy Journal, 112(3): 1475-1501.*

[102] *See soilexplorer.net.*

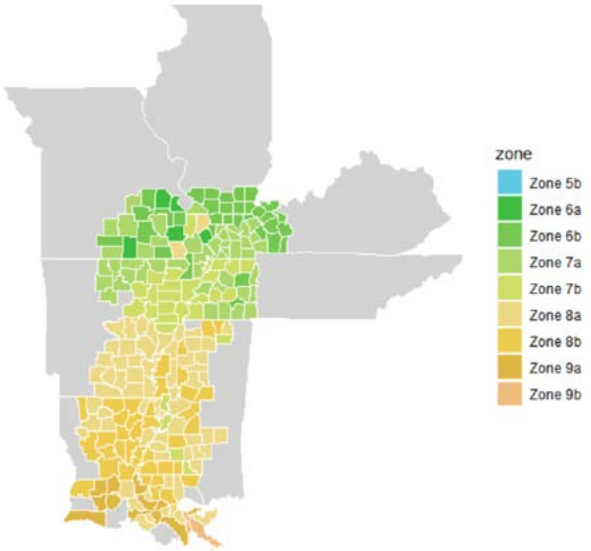
[103] *Treadway, N., Staggenborg, S., & Duncan, S. (2006). Flooding and planting decisions for soybean producers. Agronomy Journal, 98(4): 1244-1249.*

[104] *Buol, S. W., Southard, R. J., Graham, R. C., & McDaniel, P. A. (2011). Soil Genesis and Classification. Iowa State University Press.*

Climate Differences

Figure 19B presents hardiness zones across the region. The Mississippi Delta experiences a humid subtropical climate with long, hot summers and short, mild winters. The average annual temperature ranges from 60 to 70 degrees Fahrenheit, and the area receives substantial rainfall, about 50-60 inches per year, evenly distributed throughout the year. The high humidity and rainfall make the Delta ideal for crops such as cotton, soybeans, and rice, which can withstand and thrive in warm and moist conditions.

FIGURE 19B: HARDINESS ZONES IN THE MISSISSIPPI DELTA



The Mississippi Delta has a humid subtropical climate with long, hot, humid summers and mild winters. Average temperatures range from 91°F (33°C) in the summer to 41°F (5°C) in winter. The area experiences abundant yearly rainfall, averaging around 54 inches, with a high incidence of extreme weather events, including severe thunderstorms and tornadoes. The region's relatively high humidity can promote the proliferation of crop pests and diseases, posing challenges to specialty crop production. In contrast, the California Central Valley experiences a climate characterized by hot, dry summers and cool, wet winters. The average annual temperature in the Central Valley ranges from 57 to 63 degrees Fahrenheit. Summer temperatures in California's Central Valley often exceed 100°F (38°C), while winter temperatures can drop below freezing.

Irrigation is essential for agriculture in California, where water is often scarce, while the Mississippi Delta receives enough rainfall to support crops without irrigation in many areas. The Central Valley region receives much less rainfall than the Mississippi Delta, with the northern parts receiving up to 20 inches annually and the southern parts getting as little as 6 inches, primarily in winter.[105] This seasonal precipitation and long growing season can support a diverse range of specialty crops, but water availability can be a significant constraint, particularly during drought.[106] The reliance on irrigation due to low summer rainfall and the risk of frost events make cultivating specialty crops in the Central Valley a challenging task requiring careful management. For instance, grapes used for wine production thrive in this climate, as dry summers reduce the risk of grape diseases caused by fungi, while high heat aids in sugar accumulation within the grapes. Similarly, almond trees require dry weather during their late summer and early fall harvest period to prevent fungal diseases and facilitate nuts drying.

Another difference lies in the frequency and timing of frost events. Frost can damage or kill sensitive crops, and its occurrence varies between the two regions. In the Mississippi Delta, frost usually occurs from December to February. However, due to the generally milder winters, the frost is less severe compared to other regions. In the California Central Valley, frost events typically occur from late November to late February and can be more intense, especially in the southern parts of the valley. This necessitates using frost protection measures, particularly for early blooming specialty crops.

The climate differences between the two regions have substantial implications for specialty crop viability. The Mississippi Delta's high rainfall can benefit water-demanding crops like rice. However, the high humidity and incidence of severe weather events may limit the viability of certain specialty crops susceptible to fungal diseases or physical damage. By contrast, the California Central Valley's hot, dry summers provide an excellent environment for heat-loving specialty crops

[105] *Dettinger, M. D., Cayan, D. R., Meyer, M. K., & Jeton, A. E. (2004). Simulated hydrologic responses to climate variations and change in the Merced, Carson, and American River basins, Sierra Nevada, California, 1900–2099. Climatic Change, 62(1-3), 283-317.*

[106] *Howitt, R., Medellín-Azuara, J., MacEwan, D., Lund, J. R., & Sumner, D. A. (2014). Economic analysis of the 2014 drought for California agriculture. Center for Watershed Sciences, University of California, Davis, 20.*

like almonds, pistachios, and grapes, requiring dry conditions during ripening to prevent disease. However, the region's reliance on irrigation due to low annual rainfall could constrain the viability of water-intensive crops during drought years.[107]

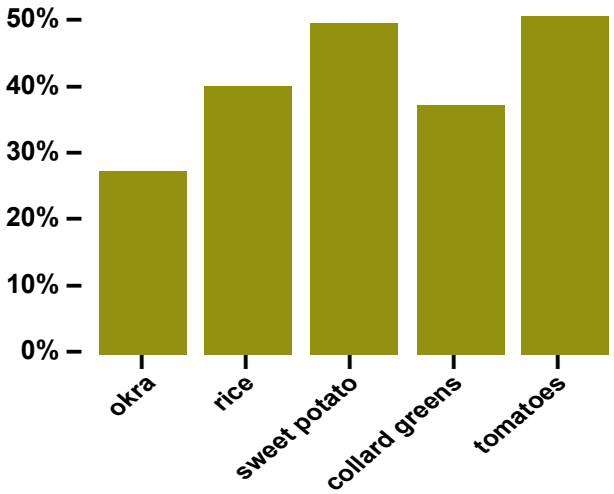
The following sections of our analysis will explore these infrastructure and labor gaps in the Delta agri-food system. That said, we can identify several areas where support might facilitate the transition to specialty crop production. These include investments in publicly available agricultural research and extension services to develop and disseminate knowledge on specialty crops,[108] improvements in infrastructure such as storage facilities and transportation links,[109] and the creation of favorable policies such as crop insurance for specialty crops or subsidies that facilitate direct sales to consumers.[110] Moreover, there is also some need to explore how to facilitate the creation of farmer cooperatives and associations, which might help individual farmers share knowledge, pool resources, and negotiate better prices with buyers.[111]

That said, the economic hurdles associated with the underlying agronomy of the region might also provide a key opportunity for specialty crops. Because of the unique growing conditions in the area, we might identify unique flavor profiles that can only be grown here. Often called "terroir," a growing area of research is how soil characteristics, climate, and other growing conditions can create added value for consumer pallets. With those added flavor-relevant values, Mississippi Delta region producers might be able to capitalize on these consumer needs and charge a higher premium.

To explore this potential for "terroir" effects in specialty crop pricing, we surveyed 1,000 U.S. consumers about their beliefs about the Mississippi Delta. We focused on their willingness to purchase Delta-Grown products, including okra, rice, sweet potatoes, collard greens, and tomatoes. The five crops were selected after consulting a team of Delta-focused agri-food researchers with the goal of identifying a diverse range of market sizes. If we assume that the goal is to sell Delta-grown products explicitly within the United States, we can then use some simple back-of-the-envelope calculations to estimate each U.S. annual market to be of the following sizes: tomatoes are a $22 billion market,[112] rice is a $9 billion market,[113] okra and collard greens are both a $112 million market,[114] and sweet potatoes are a $2 billion market.[115]

Figure 20B presents the percent of U.S. consumers in the sample who indicated they would be willing to pay some premium for the product grown in the Delta. Of the five products, sweet potatoes (50.2%) and tomatoes (51.2%) were the only crops for which over half of U.S. consumers identified as being willing to pay a premium for the Delta-grown option. By contrast, most U.S. consumers were not willing to pay a premium for okra (27.4%), rice (40.5%), and collard greens (37.7%). If we multiply that percentage by the rough estimates of total market size, we can rank the options by potential market size for Delta producers as: tomatoes ($11.3 billion), rice ($3.6 billion), sweet potatoes ($1 billion), collard greens ($42 million), and okra ($31 million).

FIGURE 20B: DELTA-GROWN PRODUCTS FOR WHICH AMERICANS WILL PAY A PREMIUM



[107] *Pittenger, D. R., Downer, A. J., Hodel, D. R., Mochizuki, M. J., & Haviland, D. R. (2011). Managing turfgrasses during drought. University of California, Agriculture and Natural Resources Publication, 8395, 1-16.*

[108] *Huffman, W.E., and R.E. Evenson. Science for Agriculture: A Long-Term Perspective. John Wiley & Sons, 2008.*

[109] *Paciarotti, C., and F. Torregiani. "The logistics of the short food supply chain: A literature review." Sustainable Production and Consumption 26 (2021): 428-442.*

[110] *Staples, A.J., T. Malone, and J.R. Sirrine. "Hopping on the localness craze: What brewers want from state-grown hops." Managerial and Decision Economics 42,2 (2021): 463-473.*

[111] *Candemir, A., Duvaleix, S. and Latruffe, L., 2021. Agricultural cooperatives and farm sustainability–A literature review. Journal of Economic Surveys, 35(4): 1118-1144.*

[112] *These are all estimated with massive underlying assumptions to each and are just reported to emphasize the importance of understanding the extent of each market in identifying and developing specialty crop retail demand for the mid-Mississippi Delta. The average American consumed 31.4 pounds of fresh, canned, and sauced tomatoes in 2019. The U.S. city average retail price for field-grown tomatoes was $2.146 per pound in January, 2024. There are 331.9 million people in the United States. This is obviously an overestimate as tomato prices vary dramatically based on the end market.*

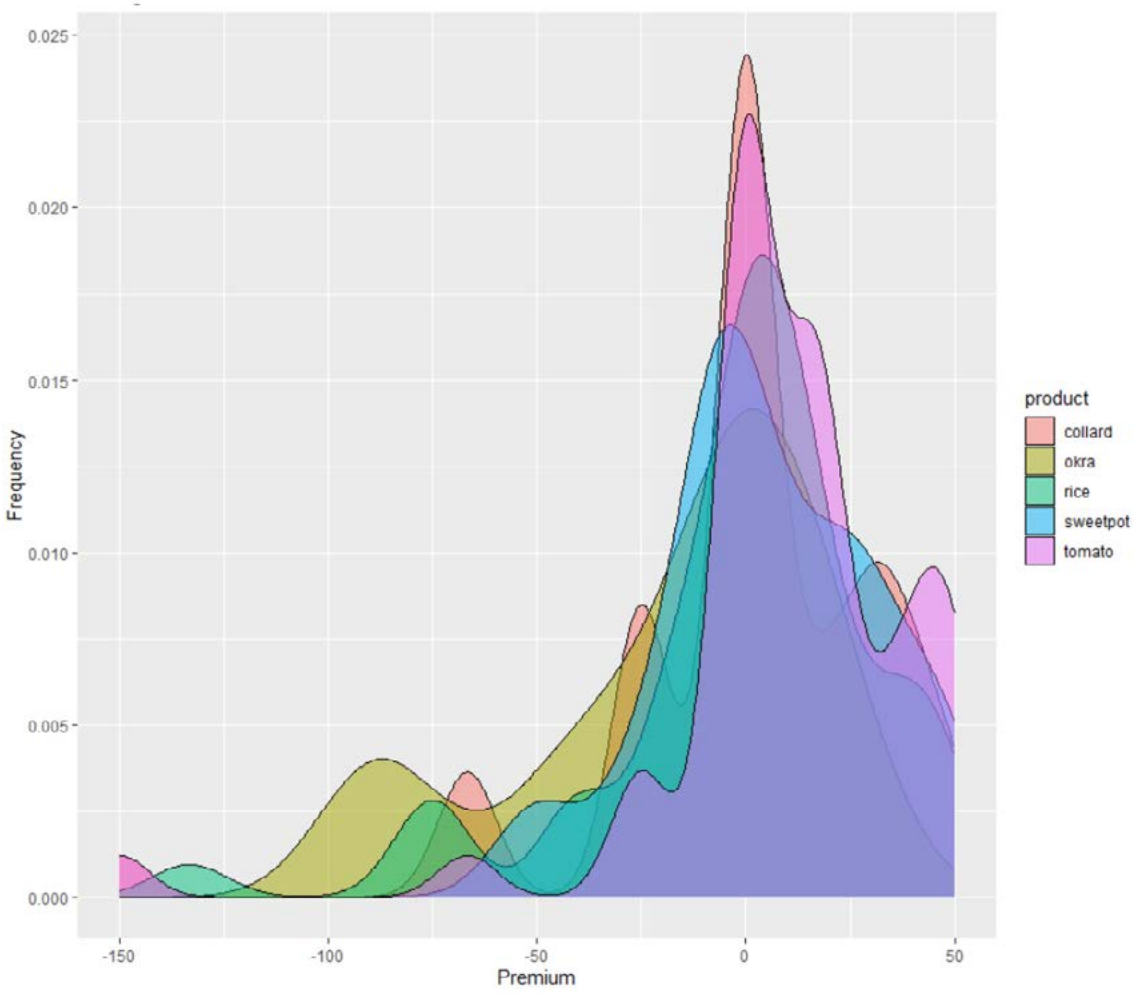
[113] *The U.S. city average retail price for white, long-grain, uncooked rice was $1.00 per pound in January 2024. The average American consumes about 26.9 pounds of rice each year. This is obviously an underestimate as rice prices vary dramatically based on the end market.*

[114] *While information on okra and collard greens are not as readily available, we assumed that okra and collard greens both represent 0.1% of the total vegetable consumption of 383 pounds per year, and the retail price for both is $0.88 per pound.*

[115] *The average American consumed 7.2 pounds of sweet potatoes per year with the average retail for fresh sweet potatoes ranging up to $0.91 per pound.*

Few successful marketing strategies target the median U.S. consumer. Instead, they focus on a market segment which is, in fact, willing to pay for the product of interest. Figure 21B presents a histogram of the percentage premium that consumers were willing to pay for Delta-Grown agri-food products. Note that the histogram indicates a long tail of negative values, suggesting that some U.S. consumers perceive Delta-grown products to be of inferior quality to an unbranded option. Surprisingly, okra is listed as having some of the worst discounts, with tomatoes having the fewest discount consumers.

FIGURE 21B: HISTOGRAM OF THE PERCENTAGE PREMIUM AFFILIATED WITH DELTA-GROWN AGRI-FOOD PRODUCTS



In Table 6B, we display market demographics for the consumers who indicated that they would indeed pay a premium for Delta-grown products. Though more research is needed, the most striking result from the demographic table is the distribution in responses. This broad distribution indicates that every specialty crop supply chain is likely to require an in-depth market analysis of the product it is trying to sell.

While this analysis suggests that the products most likely to be able to overcome the economic hurdles of the marketplace are the ones that are already grown in the region and have a large, pre-existing market, it is important to remember that this analysis has focused on developing an all-new industry in the region. That does not mean that other markets are not viable options for any producer, as these are simple market analyses. Prior to any production choice, producers would benefit from first assessing their current situation as it relates to the potential for scalability and growth.

TABLE 6B: DEMOGRAPHICS OF RESPONDENTS WHO INDICATED A POSITIVE PREMIUM FOR DELTA-GROWN

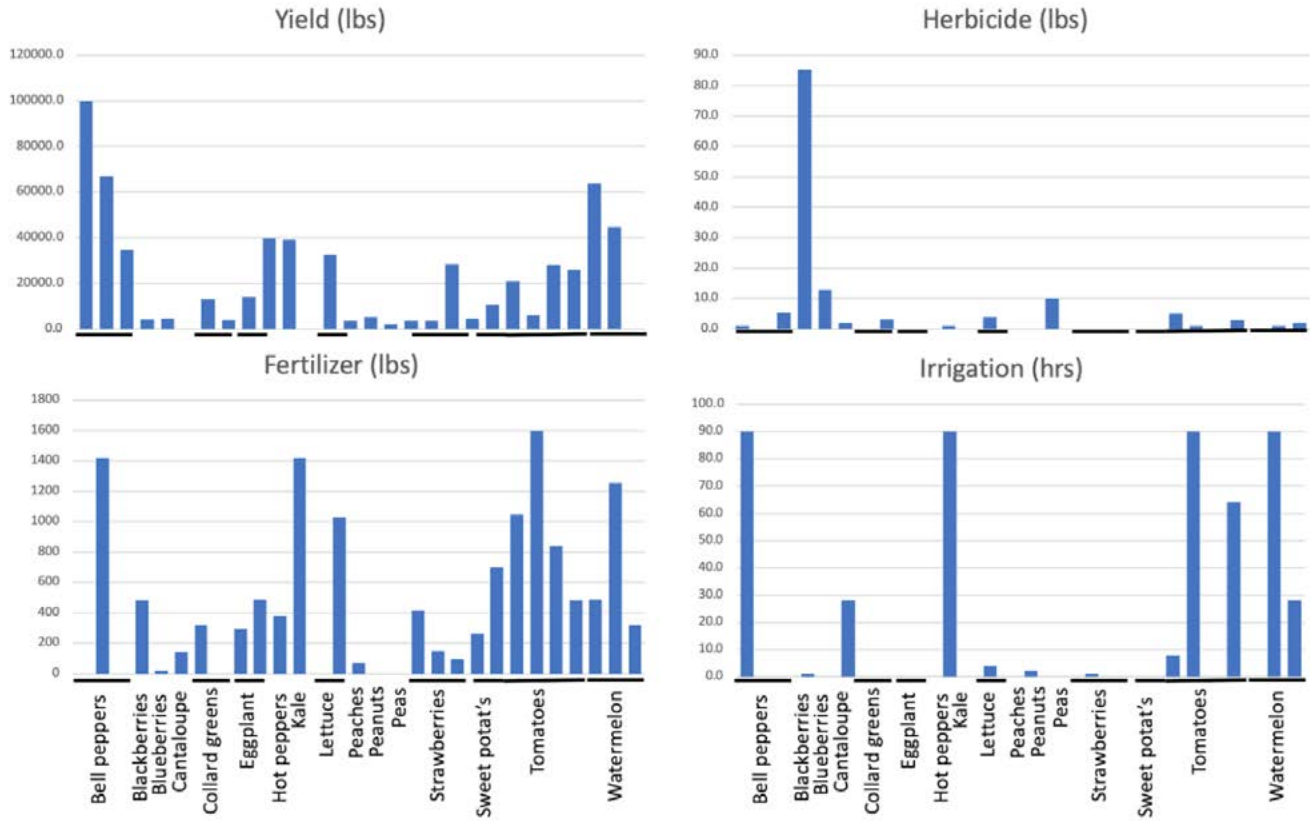
CATEGORY	OKRA	RICE	SWEET POTATO	COLLARD GREENS	TOMATOES
Age 18 - 24	6%	4%	4%	4%	4%
Age 25 - 34	11%	10%	10%	11%	9%
Age 35 - 44	21%	19%	18%	20%	17%
Age 45 - 54	18%	19%	18%	21%	20%
Age 55 - 64	19%	25%	21%	18%	22%
Age 65 - 74	21%	19%	24%	21%	22%
Age 75 - 84	3%	4%	4%	4%	6%
Age 85 or older	0%	0%	0%	0%	0%
Midwest Region	27%	27%	26%	27%	25%
Northeast Region	18%	19%	20%	18%	20%
South Region	40%	35%	38%	39%	39%
West Region	15%	19%	16%	16%	16%
Income Less than $10,000	6%	4%	7%	6%	8%
Income $10,000 - $19,999	7%	7%	14%	6%	13%
Income $20,000 - $29,999	11%	12%	11%	11%	10%
Income $30,000 - $39,999	11%	10%	10%	12%	10%
Income $40,000 - $49,999	10%	8%	9%	8%	9%
Income $50,000 - $59,999	13%	12%	11%	13%	12%
Income $60,000 - $69,999	7%	7%	6%	7%	7%
Income $70,000 - $79,999	6%	7%	6%	6%	6%
Income $80,000 - $89,999	7%	8%	8%	8%	8%
Income $90,000 - $99,999	5%	6%	6%	5%	6%
Income $100,000 - $149,999	13%	14%	5%	13%	5%
Income More than $150,000	6%	6%	6%	5%	6%
Percent Yes	27%	40%	50%	38%	51%

APPENDIX C: CROP INPUTS

This appendix was written by Dr. Emily Moberg.

	YIELD	SEEDS OR PLANTS	LIME	FERTILIZER	HERBICIDE	INSECTICIDE	FUNGICIDE	IRRIGATION	LABOR	MACHINERY	BLACK PLASTIC / DRIP LINES	DIESEL FUEL	SOURCE
	lbs / acre; # per acre in red	#; lbs in red	tons	lbs; compost in red	lbs; acre in red	pt; appl. or acres in red	acre; oz in red	hrs; mos in red	hrs	acre; trips in red	Acre (or, as specified)	gal	
Bell peppers	100000.0	12000.0	0.5	1419.0	1.0	6.0	3.0	90.0		1.0	1.0		KY
Bell peppers	66908.2			130680.0		1.0			697.0		87k ft plastic mulch & drip tape		MO
Bell peppers	34800.0	12000.0	0.5	485.0	5.3	1.4	5.7		32.4				MO
Blackberries	4342.8	1189.0	0.0	16.1	85.3	0.3	36.4	1.0	52.1	4.3			MO
Blueberries	4658.1	109.9		146.9	12.9	5.7	36.3	5.6	20.4	20.5			MO
Brussel sprouts													
Cantaloupe	4800.0	3600.0	0.5	320.0	2.0	1.0	2.0	28.0	13.5	1.0	1.8 roll		MO
Chestnuts													
Collard greens	13068.0			131 yards		21.8		28314 ft drip irr	435.6		1633 hoops		MO
Collard greens	3900.0	16.0	0.5	295.0	3.3	1.7	0.9	1 acre-in	7.4	1.0			MO
Eggplant	14000.0			490.0		70.0			280.0				IA
Eggplant	39600.0	6000.0	1.0	380.0	3.0	6.0	10.0		15.0	1.0			MO
Hazelnuts													
Honeydew													
Hot peppers	39000.0	12000.0	0.5	1419.0	1.0	6.0	3.0	90.0		1.0	1.0		KY
Kale													
Lettuce	32500.0	14500.0	0.5	1030.0	4.0	1.0	1.0	4.0	15.0	1.0			KY
Lettuce	3500.0	52.5		70.0					206.5				IA
Lettuce	28314.0			131 yards		1.0			413.8		1633 hoops		MO
Muskmelon													
Peaches	5142.9	15.7		1 acre	1.0	0.9	0.9	2.1	7.6	1.0			MO
Peanuts	2200.0	150.0	0.3		9.9	0.7	5.7		2.5			15.0	MS
Peas	3500.0	192.5		420.0					245.0		490 trellis		IA
Pecans													
Strawberries	3750.0	75.0		150.0		0.3		1.0	72.0				IA
Strawberries	28335.8	28314.0		91.5		13.6	697.0	1.0	1023.7	1.0	6882 feet black plastic mulch		MO
Strawberries	4500.0	5000.0		262.5		1.0			87.8				MO
Sweet potatoes	10500.0	6650.0		700.0					206.5				IA
Sweet potatoes	21000.0	17000.0	0.5	1050.0	5.1	14.1	1.0	8.0	8.0	1.0			MO
Tomatoes	6000.0	4500.0	0.5	1598.0	1.0	1.0	1.0	90.0	15.0	1.0	1.0		KY
Tomatoes	28000.0			840.0					332.5		280 cages		IA
Tomatoes	26000.0	4500.0	0.5	485.0	3.0	3.9	170.0	64.0	18.1	1.0	1.8 roll		MO
Tomatoes	63728.3	5793.5		490.1		13.6			1285.0		8712 feet plastic mulch		MO
Turnips													
Walnuts													
Watermelon	44800.0	800.0	0.5	1254.4	1.0	1.0	1.0	90.0	16.0	1.0	1.0		KY
Watermelon	2400	800	0.5	320	2	1	102	28	11.7	1	1.4 roll		MO

FIGURE 1C: YIELD (TOP RIGHT) AND INPUTS (AS NOTED) FOR 1 ACRE OF PRODUCTION FOR DIFFERENT SPECIALTY CROPS



APPENDIX D: CROP MAPPING

This appendix was written by Dr. Emily Moberg.

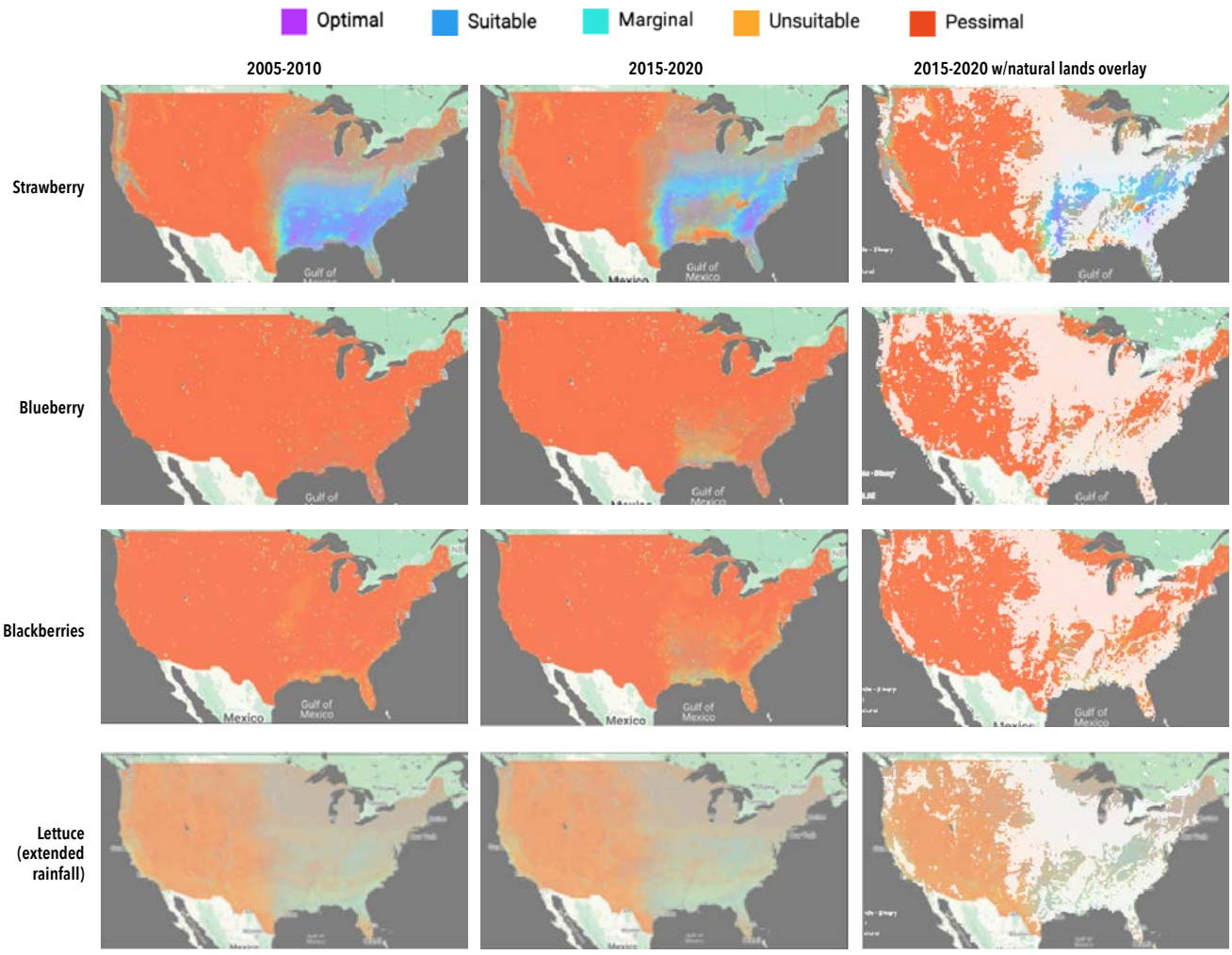
These maps were created using the crop parameters from FAO's ECOCROP. Unless otherwise noted, the optimal precipitation and temperature were used. The crop-cycle was the average between the minimum and maximum cycle length. The summary for each crop is listed below.

CROP LIST	SCIENTIFIC NAME	SOIL TEXTURE	SOIL FERTILITY	SOIL PH OPT. MIN	SOIL PH OPT. MAX	OPTIMAL TEMP (MIN, CELCIUS)	OPTIMAL TEMP (MAX, C)	ABS. MAX TEMP ('C)	CROP CYCLE MIN LEN (DAYS)	CROP CYCLE MAX LEN (DAYS)	OPTIMAL PRECIP (MIN, MM)	OPTIMAL PRECIP (MAX, MM)	LIFECYCLE
Strawberries	Fragaria x ananassa	medium, organic	moderate	6	6.8	11	24	28	180	270	600	900	perennial
Blueberries	Vaccinium	medium, organic	moderate	4	5	18	30	42	160	200	900	1100	perennial
Blackberries	Rubus	medium, organic	high	5.5	6.5	17	23	28	120	180	800	1200	perennial
Lettuce	Lactuca	medium, light	moderate	6	7	12	21	30	35	85	1100	1400	annual, biennial
Collard greens	Brassica oleracea var viridis	medium, organic	high	6	7	12	20	25	100	130	900	1600	annual, biennial
Kale	Brassica oleracea var sabellica	medium, organic	high	6	7	12	20	25	100	130	900	1600	annual, biennial
Walnuts	Juglans	medium	high	5.5	6.5	15	30	40	150	180	800	1700	perennial
Chestnuts	Castanea	medium, light	moderate	6	7	15	19	30	150	210	1000	1100	perennial
Peanuts	Arachis hypogaea	medium	high	5.5	6.5	22	32	45	90	150	600	1500	annual
Pecans	Carya illinoinensis	medium, light	high	5.5	7	15	35	40	140	210	600	1200	perennial
Hazelnuts	Corylus avellana	medium	moderate	6	6.5	10	24	35	150	210	900	1100	perennial
Peaches	Prunus persica	medium, light	high	5.5	6.3	20	33	35	240	270	900	1100	perennial
Tomatoes	Solanum lycopersicum (lycopersicum L.)	medium, organic	high	5.5	6.8	20	27	35	90	90	600	1300	annual
Bell peppers	Capsicum annuum	medium, organic	moderate	5.5	6.8	17	30	35	60	180	600	1250	annual
Hot peppers	Capsicum spp.	medium, organic	high	5.5	6.8	18	30	40	120	180	600	1500	perennial
Eggplant	Solanum melongena	medium, organic	high	5.5	6.8	20	35	40	70	120	1200	1600	annual
Watermelon	Citrullus lanatus	medium	high	6	7	20	35	40	90	90	500	700	annual
Cantaloupe	Cucumis melo	medium, organic	moderate	6	7.5	18	30	35	50	120	1000	1300	annual
Muskmelon	Cucumis melo	medium, organic	moderate	6	7.5	18	30	35	50	120	1000	1300	annual
Honeydew	Cucumis melo	medium, organic	moderate	6	7.5	18	30	35	50	120	1000	1300	annual
Sweet potatoes	Ipomoea batatas	0	high	5	7	18	28	38	80	170	750	2000	
Turnips	Brassica rapa	medium, light	high	6	6.8	10	17	30	40	80	900	1400	biennial
Peas	Pisum sativum	heavy, medium, light	moderate	5.5	7	10	24	30	60	140	800	1200	annual
Brussel sprouts	Brassica oleracea var gemmifera	medium, organic	high	6	7	12	20	25	100	130	900	1600	annual, biennial

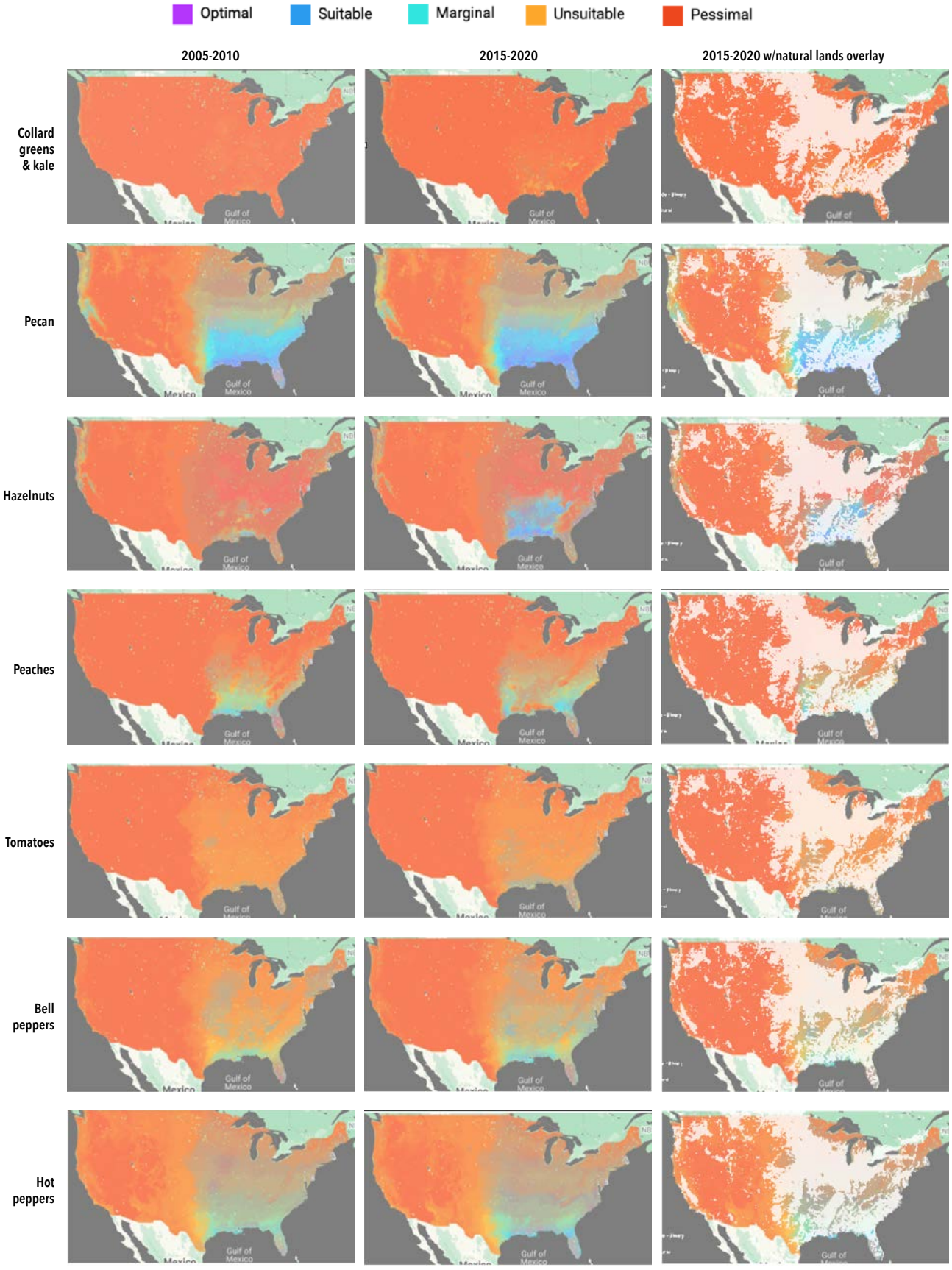
These parameters were entered into the Crop suitability tool from Peter, B.G., Messina, J.P., Lin, Z. et al.[116] Because the tool requires an initial planting date, 12 scenarios were run for each crop, time-period pair; each scenario specified initial planting date at the start of each month and extended to the average crop cycle length (e.g., for a crop with a 3 month cycle, Jan 1 – Apr 1, Feb 1 – May 1, etc.). The results of the 12 scenarios were overlaid on each other. Thus, areas that are suitable for only a growing cycle starting at a specific point are likely to appear very faintly, while those that are suitable for many planting-dates will appear very bright. Note also that these are for optimal conditions (unless noted), without consideration for irrigation or interventions like greenhouses that modulate temperature. With these interventions, many plants may be suitable in many more areas. The later time period (close to present) is intended to directionally capture the change in suitability from historical growth; future climatic change is likely to have less overall water availability that is concentrated in larger rainfall events and larger temperature extrema, which is likely to accelerate any differences.

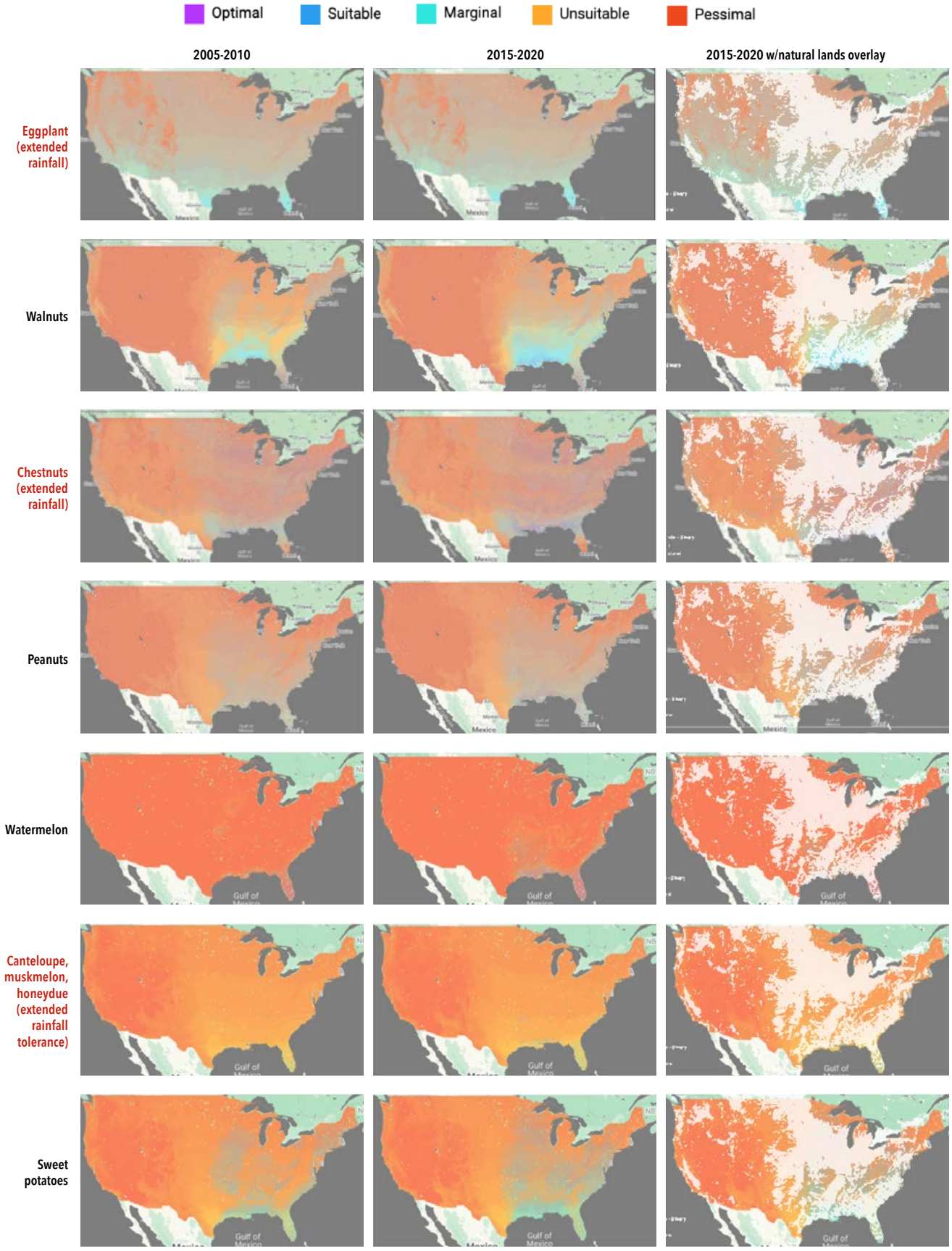
However, we do expect that the less suitable a crop is for a location without intervention, the more inputs (infrastructure, water, etc.) will be required vis-à-vis the same crop in a more suitable area.

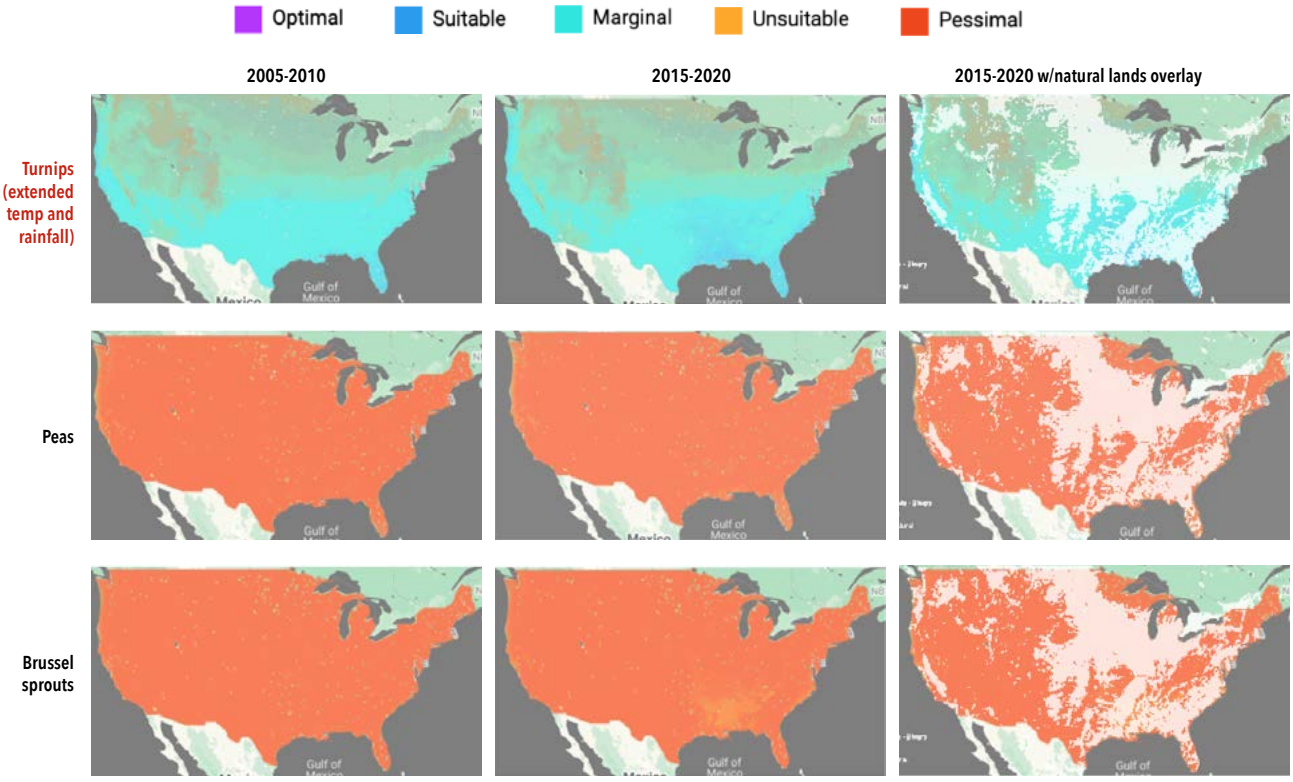
Illustration of natural areas nationally that are at risk due to crop expansion, unless intentional shifts like that proposed by The Next California are implemented. Crop suitability in two time periods (early, 2005-2010; late 2015-2020) and overlaid with natural lands mask (white mask shows human-altered lands). Suitability is highest for purple and lowest for red. Because each map is an overlay with suitability over the year, faint colors indicate that an area is suitable to grow the crop only for a short duration. In the last chart, any non-white lands that are blue and purple indicate natural lands that could be at risk from expansion of the focal crop – which The Next California wants to avoid.



[116]*Crop suitability tool from Peter, B.G., Messina, J.P., Lin, Z. et al. Crop climate suitability mapping on the cloud: a geovisualization application for sustainable agriculture. Sci Rep 10, 15487 (2020). https://doi.org/10.1038/s41598-020-72384-x was used to generate maps.*


Optimal
Suitable
Marginal
Unsuitable
Pessimal
2005-2010
2015-2020
2015-2020 w/natural lands overlay
Collard greens & kale
Pecan
Hazelnuts
Peaches
Tomatoes
Bell peppers
Hot peppers
Gulf of Mexico


Optimal
Suitable
Marginal
Unsuitable
Pessimal
2005-2010
2015-2020
2015-2020 w/natural lands overlay
Eggplant (extended rainfall)
Walnuts
Chestnuts (extended rainfall)
Peanuts
Watermelon
Canteloupe, muskmelon, honeydue (extended rainfall tolerance)
Sweet potatoes



Crop Summaries:

- Strawberries seem to be increasingly suitable to grow farther north in both the west coast and east of the Mississippi river, although some Gulf regions lose suitability. In both the Southeast and West Coast, natural lands are at risk of conversion to strawberry cultivation.
- Blueberries seem to be increasingly suitable to grow in the South and Gulf region of the US, but primarily within lands that are already disturbed.
- Blackberries seem to increasingly expand their range throughout the South into the area east of the Mississippi overall, with growing seasons in late spring / early summer. There are some natural lands in the South that are at risk of conversion.
- Lettuce, for optimal precipitation and temperature conditions, showed as unsuitable throughout the entire US. When rainfall suitability was extended to the entire possible range, most of the US east of the Mississippi and some of the West Coast become suitable during some of the year. Natural lands in both areas are at risk of conversion.
- Collard greens and kale are most suitable in the early period in spring in the mid-Delta region and on the far west of the West Coast. The suitability expands in the South and along the West Coast (see light orange areas in Louisiana and along the coast in the west). Some natural lands may be at risk of conversion, although since suitability is shown as so low in this model, additional work is likely needed to better assess risk.
- Pecans have similar suitability in both periods, in central West Coast and in the South (esp. Gulf States); the suitability in both regions increases in the later period. Natural lands are at risk of conversion in both areas.
- Hazelnuts are suitable for many growth cycles along with northern West Coast and central South. The areas of suitability increase dramatically in the latter region, putting some natural lands at risk. Areas in the West Coast also may be at risk.
- Peaches are suitable largely in the US south, with greater suitability in the later period in most areas (although some retraction in the Gulf coast). Some natural lands may be at risk of conversion.
- Tomatoes are suitable primarily in the South, with increased suitability farther north in the later period. Some natural lands within patchworks of disturbed land / cropland may be at risk of conversion.

- Bell peppers and hot peppers are primarily suitable east of the Mississippi, with patchy suitability replaced by more continuous suitability over time. Many natural lands in the South could be at risk of conversion. Some areas in the northern and central West coast may also be at risk (short duration of suitability).
- Tomatoes are suitable primarily in the South, with increased suitability farther north in the later period. Some natural lands within patchworks of disturbed land / cropland may be at risk of conversion.
- Bell peppers and hot peppers are primarily suitable east of the Mississippi, with patchy suitability replaced by more continuous suitability over time. Many natural lands in the South could be at risk of conversion. Some areas in the northern and central West coast may also be at risk (short duration of suitability).
- Eggplants, for optimal precipitation and temperature conditions, showed as unsuitable throughout the entire US. When rainfall suitability was extended to the entire possible range, they are somewhat suitable throughout much of the US, with greatest suitability in the southernmost regions. Some of these areas are natural lands.
- Walnuts are primarily suited to the US south and the West Coast. The suitability of those areas increased over time. Natural lands near human disturbance / cropland in both areas may be at risk of conversion.
- Chestnuts, for optimal precipitation and temperature conditions, showed as unsuitable throughout the entire US. When rainfall suitability was extended to the entire survivable range, they are suitable in many areas east of the Mississippi and in the West Coast. Suitability expands, especially north over time. In the West Coast, the suitable areas are largely already cropland; some patchy areas in the South and Appalachian regions may be at risk.
- Peanuts are mostly suitable in both periods in the US South and Midwest, with similar suitability over time. Some natural lands may be at risk.
- Watermelons in the early period were suitable only in a few patches, primarily in the Gulf and Florida; this suitability appears to expand over time. Relatively few natural lands seem to be at risk for conversion.
- Cantaloupe, muskmelon, and honeydew, for optimal precipitation and temperature conditions, showed as unsuitable throughout the entire US. When rainfall suitability was extended to the entire survivable range, they are somewhat suitable to grow in the US south, especially along the Gulf of Mexico coast. Some of these coastal ecosystems may be at risk of conversion.
- Sweet potatoes, for optimal precipitation and temperature conditions, showed as unsuitable throughout the entire US; they remain unsuitable when the entire survivable rainfall range is considered. When both the survivable precipitation and temperature are considered, it is suitable in much of the area east of the Mississippi. Some natural lands may be at risk.
- Turnips, for optimal precipitation and temperature conditions, showed as unsuitable throughout the entire US; they remain unsuitable when the entire survivable rainfall range is considered. When both the survivable precipitation and temperature are considered, much of the US is suitable throughout the entire year. Natural lands across the US could be at risk of conversion.
- Peas have suitability only for a few months in each growing location, primarily along the west coast and South (especially Florida). In the later period, it appears suitability expands in both the West Coast and in Florida, with natural lands in the West Coast primarily at risk for conversion.
- Brussels sprout suitability is only for a few months and is concentrated on the West Coast (very coastal). Some natural lands may be at risk of conversion.

APPENDIX E: ENVIRONMENTAL IMPACTS AND BENEFITS OF SPECIALTY CROPS – ASSESSMENT & MARKET OPPORTUNITIES

This appendix was written by Dr. Emily Moberg.

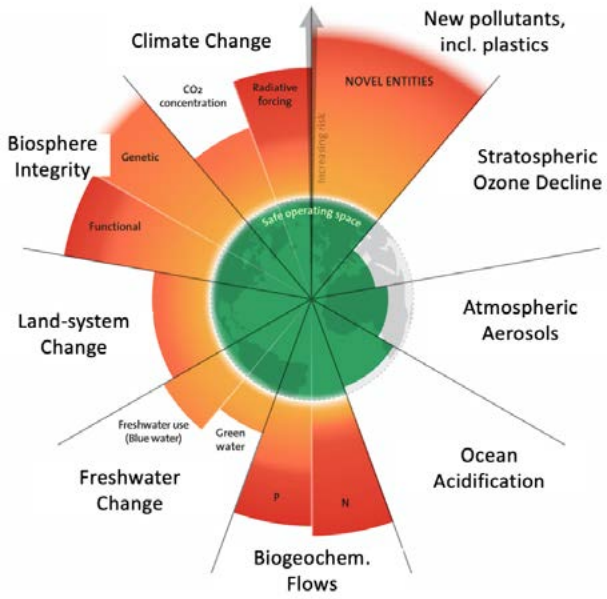
This appendix is meant to serve as a primer to the international goals on natural resource use, how specialty crops' impacts fit into those goals, and how different stakeholders within specialty crop supply-chains can engage with each other and with larger action initiatives.

Environmental Impacts of Specialty Crops in Context

Human activity is using natural resources at a faster rate than they can be replenished, while degrading ecosystems in ways that threaten their continued function. The concept of "planetary boundaries" formalizes how much of each resource can be used.[117] Currently, we are vastly exceeding the boundaries for six of the nine boundaries that are assessed (Figure 1E).

FIGURE 1E: PLANETARY BOUNDARIES FOR 2023

Red wedges indicate exceeded boundaries.[118]



For many of these resources, especially land-system change, climate change, biogeochemical flows, and biosphere integrity, the food system is a major contributor; in many cases, we know that the safe operating space cannot be reached without major action in the food sector.

This has led to major international initiatives by state and industry actors to take bold action. For example:

- **Greenhouse gas emissions:** The international community has decided to aim for limiting end-of-century temperature increases to 1.5°C (about 2.7°F) as part of the Paris Agreement. This requires GHG emissions to reach net-zero by mid-century. Corporations can participate in the Race to Zero through frameworks like the Science Based Targets Initiative.[119] Reporting options for corporations through standards like the International Financial Reporting Standards (formerly TCFD)[120] have grown and are becoming increasingly mandatory at the national level.
- **Land use and biodiversity:** Through the international Kunming-Montreal Global Biodiversity Framework, the loss of habitats, both for climate and biodiversity, needs to approach zero by 2030.[121] Frameworks like the Science Based Targets for Nature help translate these goals for corporations.
- **Nutrient cycling and pollution:** Through the international Kunming-Montreal Global Biodiversity Framework, by 2030 the pollution from sources like nutrients and pesticides, as well as plastic, need to be reduced by half.[122] Local municipalities may have additional regulations; for example, the sensitive Chesapeake Bay has strict goals within the watersheds that feed the bay.

[117] Rockström, J., Steffen, W., Noone, K., Persson, Å., et.al. 2009. A safe operating space for humanity. Nature 461: 472-475 DOI 10.1038/461472a

[118] Planetary boundaries for 2023: https://www.stockholmresilience.org/research/planetary-boundaries.html Licenced under CC BY-NC-ND 3.0 (Credit: Azote for Stockholm Resilience Centre, Stockholm University. Based on Richardson et al. 2023, Steffen et al. 2015, and Rockström et al. 2009)

[119] https://climatechampions.unfccc.int/system/race-to-zero/ [120] https://www.ifrs.org/sustainability/tcfd/

[121] https://www.cbd.int/gbf/targets

[122] CBD, supra

- **Water use:** As part of the international Sustainable Development Goals, goals for water quality and stress are set.[123] In many locations, water stress is acute and expected to increase with climate change. Frameworks like the Science Based Targets for Nature help translate these goals for corporations.

What This Means for the Food System and for Specialty Crops

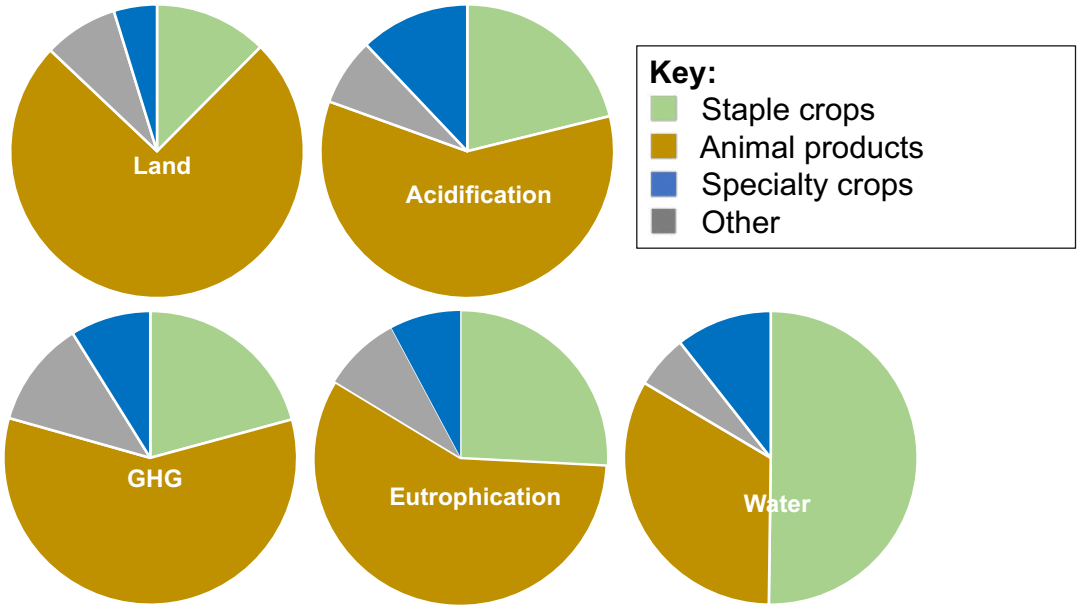
Food system contributions to each category:

- **Greenhouse gas emissions:** The food system produces about one-third of global greenhouse gas emissions. These emissions need to be reduced by an absolute 80% by 2050.[124]
- **Land use:** Over 40% of the earth's ice-free land is used for agriculture.[125] Agriculture also drives about 90% of deforestation[126] and loss of other natural habitats. The loss of additional natural lands needs to steadily decline and reach zero by 2030.
- **Nutrient cycling and pollution:** Agricultural pollution via nutrients and pesticides is one of the leading causes of freshwater degradation. In many locations, it is the leading driver.[127]
- **Water use:** 70% of global freshwater withdrawals are for agriculture, and agriculture is the leading cause of local water stress.[128]

Specialty crops do not have a negligible impact in any environmental impact category, although their impact per kilogram of food is often better than other food products. Figure 2E shows how different food products contribute to the footprint of the entire food system. Each component of the food sector will need to make significant changes to do their fair share towards achieving the goal of reining natural resource use back into the planetary boundaries' safe operating space.

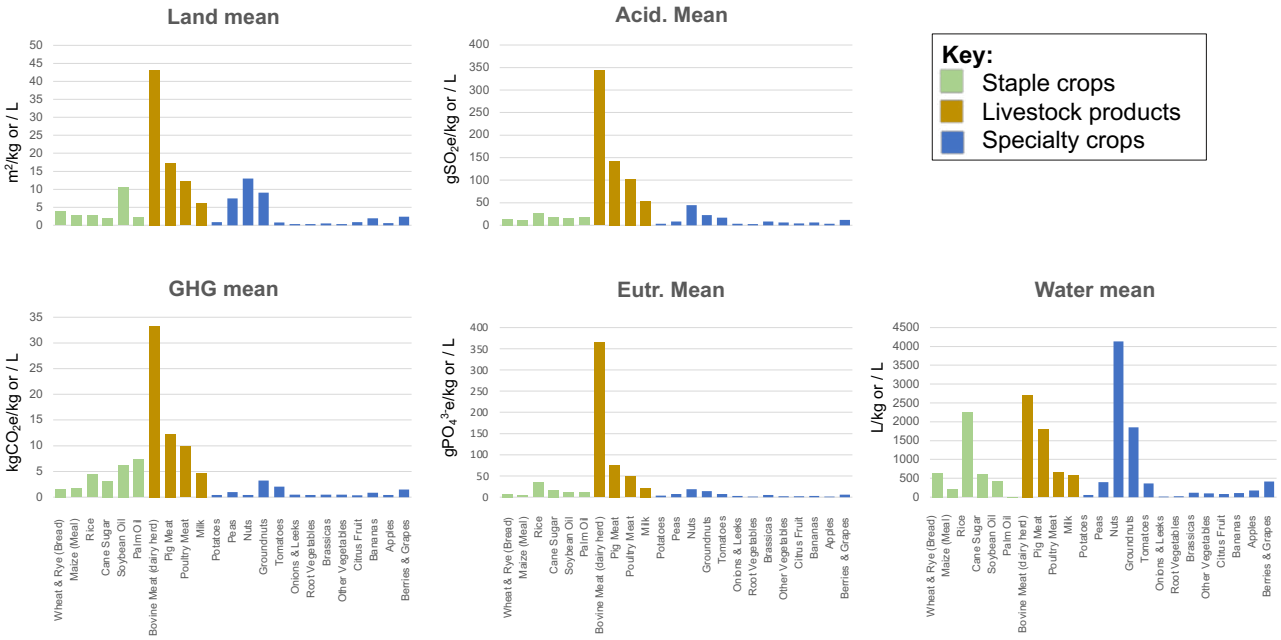
FIGURE 2E: PROPORTIONAL CONTRIBUTIONS OF THE FOOD SYSTEM'S ENVIRONMENTAL IMPACTS BY FOOD GROUP

Note that specialty crops contribute about 5-12% of the total food system emissions for the five categories shown.[129]



[123] *https://sdgs.un.org/goals*
[124] *Summarized at https://wwfint.awsassets.panda.org/downloads/dcf_critical_for_1_5_pathway___summary_and_techincal_methods.pdf*
[125] *Ellis, E. C., Klein Goldewijk, K., Siebert, S., Lightman, D., & Ramankutty, N. (2010). Anthropogenic transformation of the biomes, 1700 to 2000. Global Ecology and Biogeography, 19(5), 589-606. and FAO. Our World in Data (https://ourworldindata.org/land-use) has a great summary.*
[126] *https://www.fao.org/newsroom/detail/cop26-agricultural-expansion-drives-almost-90-percent-of-global-deforestation/en*
[127] *https://www.fao.org/3/i7754e/i7754e.pdf*
[128] *FAO. 2021. The state of the world's land and water resources for food and agriculture – Systems at breaking point. Synthesis report 2021.Rome. https://doi.org/10.4060/cb7654en*
[129] *Data from Poore & Nemecek (infra), using supplementary Data2.xls.*

FIGURE 3E: THE AVERAGE LAND, GHG, ACIDIFICATION, EUTROPHICATION, AND WATER FOOTPRINTS FOR SELECTED FOOD PRODUCTS



Environmental Impacts of Specialty Crops Relative to Other Foods

Specialty crops contain a huge number of different crops that are grown in vastly different conditions, with varying levels of infrastructure and inputs. Consequently, the environmental impacts vary greatly across different crops and varietals.

Figure 3E shows five environmental impacts for selected foods among staple crops, livestock products, and specialty crops.[130] While many specialty crops have impacts that are smaller than both staple and animal foods, some specialty crops may have a higher impact, particularly in land and water use.

Given that the planetary boundaries for land-system change, GHG emissions, biogeochemical flows (to which the eutrophying emissions are linked), and freshwater change are already in excess, even relatively small intensities are likely required to shrink significantly at a global scale. Locally, these impacts may require even more attention; for example, the impacts of water extraction or pollution of drinking water supply with fertilizer runoff are determined by the local conditions and needs.

Environmental Impacts of Specialty Crops Across the Supply-Chain

Environmental impacts add up throughout the life-cycle of a product. Some impacts occur on the farm, then the impacts of storage, transportation, and processing are added before the food reaches the consumer. Finally, impacts from cooking and disposal of any waste are accrued.

For land and water impacts, almost 100% of impacts occur in the farming stage across staple, livestock, and specialty crops. For acidifying and eutrophying emissions for staple crops, 10-30% of emissions may occur in the processing stage, with a potential 5-10% also in the retail stage; almost all these emissions for livestock occur on farm. For specialty crops, about 75-90% of acidifying emissions occur on farm, with 10-15% from packaging, and 5-10% in retail; all eutrophying emissions occurred on farm.[131]

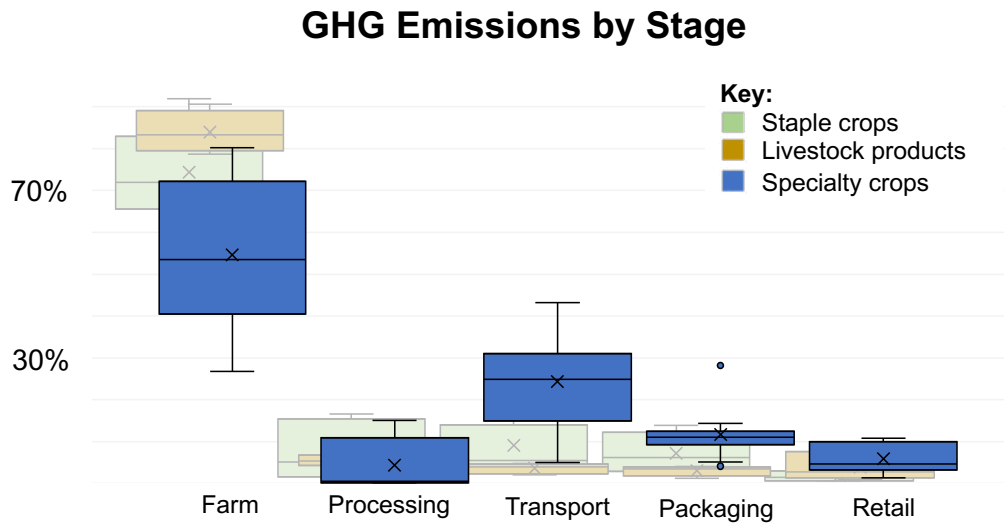
Greenhouse gas emissions across the life-cycle are more variable, as Figure 4E shows.[132] Specialty crops tend to have a higher percentage of their total emissions related to transport and to retail. This is largely driven by cold-storage needs.

[130] *Produced with data from Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. Science, 360(6392), 987-992. Data2.xls appendix.*

[131] *Calculations with data from Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. Science, 360(6392), 987-992 from the full dataset, available from Oxford University, and from supplementary materials Data2.xls.*

[132] *Calculations with data from Poore J. & Nemecek, supra.*

FIGURE 4E: PERCENTAGE OF TOTAL GHG EMISSIONS THAT OCCURS IN EACH STAGE
(ON FARM, PROCESSING, TRANSPORT, PACKAGING, AND RETAIL) FOR THE SAME CROPS AS FIGURE 3

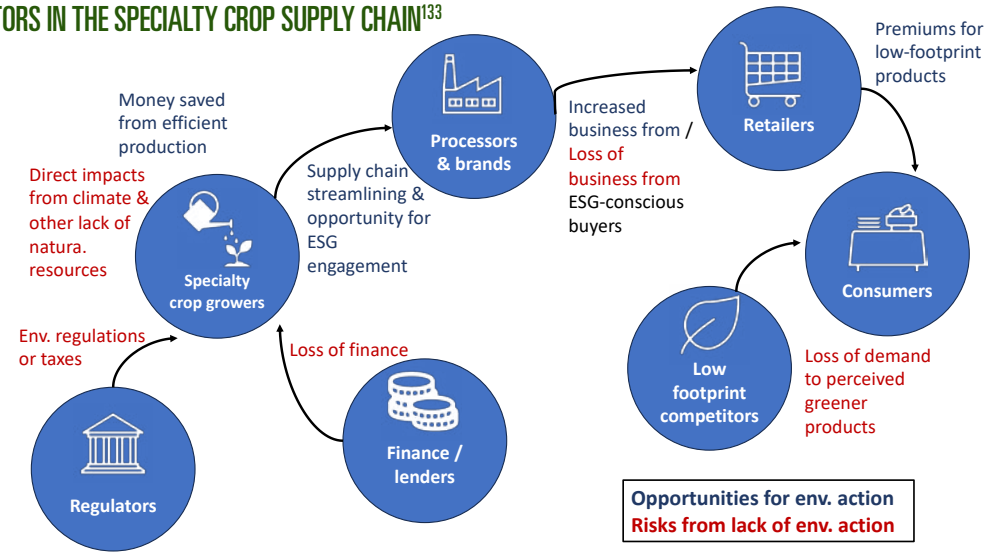


Overall, even for greenhouse gasses, the majority of impacts are concentrated on farm, although there are significant emissions from downstream actors.

Why Take Action?

Specialty crops have often passed under the radar for environmental impacts while the focus has been on the huge volumes of staple crops and large total impacts of animal-source products. However, both regulators, investors, and business-to-business interactions increasingly look at environmental performance, often starting with climate impact. In some cases, the relatively good environmental performance of specialty crops may present an opportunity; however, given the stringency of needed change, even products with relatively good current performance will face risks without action as time passes.

FIGURE 5E: GRAPHIC SHOWING POTENTIAL RISKS AND OPPORTUNITIES FROM ENVIRONMENTAL ACTION FOR DIFFERENT ACTORS IN THE SPECIALTY CROP SUPPLY CHAIN[133]



In addition, many other risks, like forced labor, are prevalent in specialty crop supply chains, and increased scrutiny and action for environmental action can be complementary to actions to reduce these risks.[134]

[133] *Figure modified from WWF & UNGC's Setting Science-Based Targets in the Seafood Sector: Best Practices to Date (https://files.worldwildlife.org/wwfcmsprod/files/Publication/file/8cn3jb0kvv_Seafood_Guide_20220329_v3.pdf)*
[134] *Blackstone, N.T., Rodríguez-Huerta, E., Battaglia, K. et al. Forced labour risk is pervasive in the US land-based food supply. Nat Food 4, 596–606 (2023). https://doi.org/10.1038/s43016-023-00794-x*

Frameworks for Assessing Environmental Impacts or Services

A critical step to both initiating environmental action and monitoring progress is measuring those impacts. In almost all cases, progress is measured by the difference in impact in one time period to another. How environmental impacts are quantified depends on the context and the goals of the assessment. Several of these approaches that are relevant for food and specialty crops are detailed here:

- **Corporate** or organizational level accounting focuses on the impacts from all the activities conducted by a business. This is typically what is reported in corporate sustainability reports and is also often the scale used when companies participate in target-setting frameworks. Corporate reporting often includes the upstream impacts for purchased products and services as well as downstream impacts for the use of the product.
- **Product** accounting focuses instead on the footprint of a particular product. The results of Figure 3E, for example, shows product-level footprints; these are usually given per unit of product. This is useful both when understanding how particular produced or purchased products contribute to a company's overall footprint and for understanding the relative role of different foods in a diet.
- **Landscape** accounting focuses on the emissions from a particular geography. This is often used to understand the impacts from the land-sector—including agriculture—and may be expressed per unit area.

Different stakeholders may use these approaches differently. For example, retailers with science-based targets may seek engagement with their suppliers and offer premiums or set requirements for environmental performance in contracts to help achieve their goals. Municipalities may have reward programs or fines related to performance. Some independent certifications use similar concepts as part of their process.

The following sections aim to provide examples of commonly used frameworks and key concepts to help navigate individual opportunities and interactions.

Life-cycle Assessment[135]

A life-cycle assessment (LCA) is a common method for quantifying impacts; many accounting systems are based on this type of thinking, especially for a product or service. An LCA essentially quantifies the potential impacts of the inputs and outputs of a product or service over its life cycle. A footprint is when an LCA looks at only one impact category (e.g., GHG or water).

An LCA has four phases: goal and scope definition, inventory analysis, impact assessment, and interpretation. In the goal and scope phase, one decides the boundaries methods and data requirements of the study. Next is an inventory; this is an enumeration of the specific elementary flows resulting from the identified relevant inputs (e.g. fuel or purchased soy) and outputs (e.g. GHG emissions) from the considered system. With this comprehensive inventory, the impact assessment uses characterization factors that translate the consumed and emitted flows into potential impacts. For example, in the case of carbon footprinting, emission factors based on global warming potential are applied to calculate how much GHGs are emitted expressed as carbon dioxide equivalent (CO_2e). Finally, the results are interpreted.

Companies can follow relevant standards such as ISO 14044 (Environmental management - Life cycle assessment- Requirements and guidelines), which specifies requirements and guidelines for LCAs. Some specific standards exist for specific types of products, like the EU's Product Environmental Footprint (PEF), the International Environmental Product Declaration (EPD) system and PAS2050. They will set specific rules for a product category, recognizing the processes that contribute to impacts from food, for example, are very different from those arising from construction.

[135] *This section is modified from the WWF-UNGC guide for GHG action in seafood, supra*

Greenhouse Gas Frameworks[136]

Corporate Accounting

Greenhouse gas accounting for companies almost universally follows the Greenhouse House Gas Protocol Corporate Accounting and Reporting Standard.[137] This standard breaks emissions into three "scopes":

- **Scope 1:** Direct GHG emissions
- **Scope 2:** Purchased electricity, steam, heat and cooling indirect GHG emissions
- **Scope 3:** Other indirect GHG emissions (upstream and downstream)

For food retailers, almost all of their emissions will be "Scope 3," largely from their purchased product.

In general, most scrutiny is given to the impacts related to a company's own operations in terms of data collection; however, the most impactful mitigation opportunities---especially in the food sector---may not be within the company's control.

Setting Targets

The Science Based Targets Initiative (SBTi) defines best practice in science-based target setting, offering resources, guidance and a methodology to help companies set targets in line with climate science. Targets submitted for approval by the SBTi are independently assessed by an expert team in line with strict criteria; this independent verification demonstrates that the company's targets are truly aligned with the targets set out in the Paris Agreement and Glasgow Climate Pact, which in turn can help to improve stakeholder confidence in the targets.

The SBTi offers online resources[138] including step-by-step guides and a corporate manual outlining the process and methodology for setting SBTs. New guidance for the forest, land, and agriculture (FLAG) sector was released in 2022.[139]

Specialty crops follow the FLAG sectoral guidance, which mandates a yearly 3.03% reduction from the base year (to farm-gate). The emissions that arise afterwards (processing, transport, etc.) will follow the standard emissions reductions required (4.2% for a 1.5C pathway) or a sectoral standard (e.g., land and sea transport sectoral guidance).[140]

Product Standards

There are multiple product standards for food products. In general, the critical things to know about the product standard are its scope and calculation requirements. Product impact calculations typically account for impacts from cradle-to-some-endpoint; this endpoint might be farm-gate to retail, etc. This means that the impact is calculated inclusive of all the contributing processes up until that point, although some processes—like capital infrastructure—may be excluded in some standards. The GHG protocol product life-cycle standard is a helpful way to think about key principles, even if it is only focused on GHG emissions.[141] An EU product environmental footprint category rule for fresh fruits and vegetables is under development.[142]

In addition to knowing which processes should be included in the assessment, another key concept is how the impacts are allocated to co-products. This happens when the emissions cannot be separated (for example, when both the flesh and seed of a crop are separated and sold; the impacts used to grow the crop need to be assigned to each product). There are several allocation methods, and standards often specify which should be used. The most important outcome is consistency and clarity on which allocation is used; otherwise, the end result will differ simply due to how the calculation was performed, not based on different performance.

Land Frameworks

There does not exist a similarly universal and well-adopted standard for measuring land-use impacts as there is for GHG emissions. The most reputable framework—the Science Based Targets for Nature Land Hub—is under development and provides valuable guidance for companies in how to engage on land impacts.

[136] *This content is modified from the WWF-UNGC guide for GHG action in seafood, supra*
[137] *GHG Protocol. (2015) Corporate Accounting and Reporting Standard. Available: ghgprotocol.org/corporate-standard*
[138] *https://sciencebasedtargets.org/resources/?tab=commit#resource*
[139] *https://sciencebasedtargets.org/sectors/forest-land-and-agriculture*
[140] *https://sciencebasedtargets.org/sectors/transport*
[141] *https://ghgprotocol.org/product-standard*
[142] *https://edepot.wur.nl/579405*

The SBTN land targets are:[143]

- **No conversion of natural ecosystems** – halting the conversion of natural ecosystems like forests, grasslands, wetlands and others to agriculture or other human use
- **Land footprint reduction** – reducing the total amount of land used to enable restoration
- **Landscape engagement** – work in landscapes to improve structure, composition, and function of ecosystems

The company characteristics and risks determine whether all or some of these targets are necessary to set; the Land Sector Guidance has specific guidance for companies to determine this.[144] For companies in the specialty crop sector, a no-conversion target and landscape engagement will be required and footprint reduction would be recommended or required based on company characteristics like size.

Note that these goals are aligned with both climate and biodiversity goals. For climate, because natural ecosystems store huge amounts of carbon, when conversion occurs, the climate footprint of the product is then dominated by those emissions (even when amortized over 20 years, as GHG accounting requires!) Eliminating habitat conversion in the near term is a key component of food sector climate roadmaps.[145] For biodiversity, the preservation of natural lands and habitat is also critical.

Similar to the GHG accounting, quantifying impact on land-use and setting a target requires data from one's own operations, points of commodity aggregation, and upstream sourcing from farms. The location of operations is critical for determining risk and monitoring progress on conversion and landscape engagement; the area of land in production and its yield is critical for the land footprint assessment.

Water Frameworks

Similar to the land-impacts, guidance on how to account for water use is not as well standardized as GHG emissions. Because the impacts of water use are determined by the local watershed, whether or not an LCA-based approach is appropriate for assessing water impacts remains controversial. Note that water-use frameworks typically focus on "blue water," which is water that is present in waterways like lakes, ponds, and rivers or underground in aquifers; this is the water that is used in irrigation or in any industrial or home use. Rainfed agriculture uses "green water" or the local precipitation—we are not as worried about the use of this water as about the extraction of blue water. However, rainfed agriculture can still negatively impact water quality from run-off, as discussed below.

The SBTN has in-progress Water Guidance that focuses both on quantity and quality (water use and nutrient pollution).[146]

The target itself requires indicators to represent both the pressure (from the company on the water) and the state of nature, a threshold for the "desired" state of nature, and some way to link the pressure and state. This requires consultation with stakeholders at the national and local level to determine which thresholds and models to link the pressure and state are appropriate.[147]

Currently, the guidance focuses on freshwater withdrawals from surface or groundwater (i.e., for specialty crops, irrigation uses; may also pertain to processing and packaging water use) and the freshwater quality from the inputs of nitrogen and phosphorus (i.e., for specialty crops, the run-off of fertilizer). A company's own operations and upstream impacts are included in the scope. At a minimum, companies must quantify the volume of water used directly by them and by their upstream supply-chain (quantity) and nutrient concentration or mass from both direct and non-point sources (although a grey-water flow rate may also be used for nonpoint sources). Runoff of nutrients from agricultural fields are considered non-point-source pollutants.

The freshwater guidance contains many more resources on the modeling and threshold work needed to set a locally appropriate target.

[143] *https://sciencebasedtargetsnetwork.org/wp-content/uploads/2023/05/Technical-Guidance-2023-Step3-Land-v0.3-Supplement.pdf*
[144] *https://sciencebasedtargetsnetwork.org/wp-content/uploads/2023/05/Technical-Guidance-2023-Step3-Land-v0.3.pdf*
[145] *https://www.fao.org/interactive/sdg2-roadmap/en/*
[146] *https://sciencebasedtargetsnetwork.org/wp-content/uploads/2023/05/Technical-Guidance-2023-Step3-Freshwater-v1.pdf*
[147] *SBTN Freshwater guidance, supra, pages 16-17*

Other Environmental Impact Frameworks

Frameworks for accounting for other environmental impacts, especially biodiversity, are in progress. For example, the SBTN is developing guidance for biodiversity target setting for corporations[148], and the Taskforce on Nature-related Financial Disclosures developed disclosure recommendations related to nature, modeled after the original climate disclosure guidance.[149]

Tools for Specialty Crops

Data Collection[150]

Data are critical for multiple stages of environmental target setting and attainment. Data are needed to set a baseline against which future progress is measured. Within this baseline, the relative impacts from different sources can be used to identify hotspots and promising targets for mitigation. As new mitigation is rolled-out, new data are collected to track (and potentially report) on progress. Thus, data help companies iteratively strategize where to intervene and track intervention efficacy.

Data collection is often highlighted as a challenge for companies. While impacts from their own operations (Scope 1 and 2 for greenhouse gases) are often easier to quantify, Scope 3 can be challenging due to low availability of data, different calculation methods across the supply chain, sourcing from a large number of suppliers across geographies, and the diversity and wide use of raw materials, packaging, and transportation across supply chains.

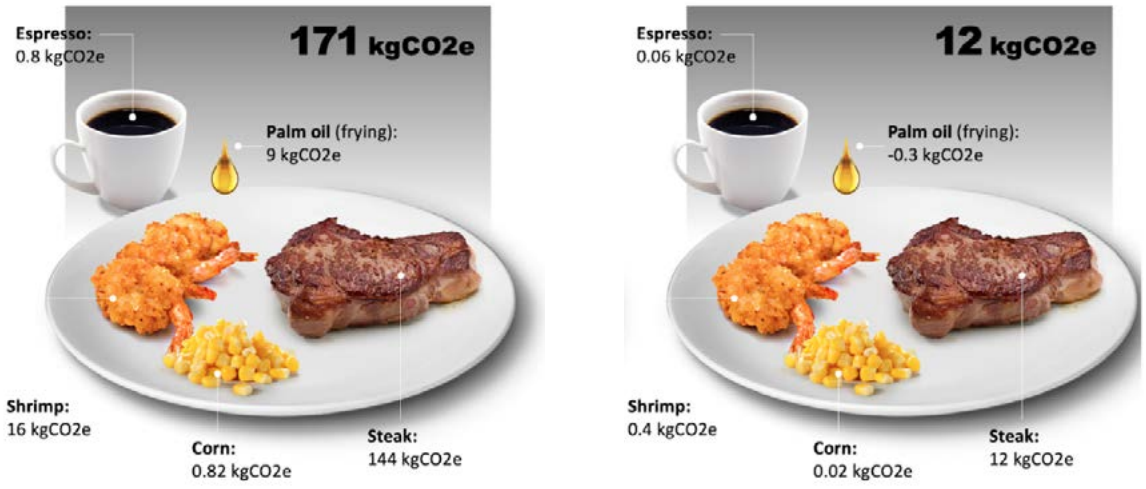
There are two types of data that companies need: primary and secondary data

- **Primary Data:** are those which are collected about specific operations; this could be energy usage in a canning facility, the yield of a particular farm, or the origin of a particular fertilizer.
- **Secondary Data:** are those which describe non-specific operations; these comprise both information like "average distance a tomato travels globally" that a company may use and "emissions factors" that link specific actions or purchases to a particular environmental impact.

Companies may face challenges with both types of data and will need to align their primary and secondary data carefully.

Collecting better data is an iterative process that improves over time. Because of the outsized effect that farm-level production has on the overall environmental impacts, primary data from farms is likely to be particularly valuable, especially given that the footprint of the same product grown differently can be 10-100x different (see Figure 6E). Having data directly from farms can help good performers tell their story and make a case that they are selling a premium product, while for poorer performers, it can provide insight into how to make large improvements and get funding to finance that mitigation.

FIGURE 6E: TWO "IDENTICAL" MEALS WITH SOME OF THE HIGHEST AND LOWEST GHG IMPACTS OBSERVED IN FARMS ACROSS THE WORLD.



[148] *https://sciencebasedtargetsnetwork.org/wp-content/uploads/2023/05/Technical-Guidance-2023-Biodiversity-Overview.pdf*
[149] *https://tnfd.global/*
[150] *This section is modified from content from the WWF-UNGC seafood guide on GHG action, supra*

Farm-Level Calculators

Farm-level calculators are a critical way to get primary data for farms. For product-level, landscape, or company-level (for farmers) assessments of environmental impact, farm-level calculators are a critical tool to translate the farming actions and inputs into environmental impacts or benefits.

There are many different calculators available, often focused on specific regions or crops. Table 1E lists tools that can model at least some specialty crops and are suitable for use across the United States.

TABLE 1E: FARM-LEVEL CROP CALCULATORS SUITABLE FOR (SOME) SPECIALTY CROPS WITHIN THE UNITED STATES. ALL TOOLS ARE FREE-TO-USE FOR GROWERS.

Tool Name	URL	Brief Summary	Format	GHG	Water	Other
COMET Farm	https://comet-farm.com/	COMET-Farm is a tool developed by Colorado State University in conjunction with the USDA and NRCS that estimates the 'carbon footprint' for all or part of your farm/ranch operation and allows you to evaluate different options for reducing GHG emissions and sequestering more carbon.	Website	✓		
Cool Farm Tool (CFT)	https://app.coolfarmtool.org/account/login/?next=/	CFT is an online greenhouse gas, water, and biodiversity calculator for farmers. It functions worldwide and can be used for both crop and livestock.	Website	✓	✓	✓
EX-ACT	https://www.fao.org/in-action/epic/ex-act-tool/suite-of-tools/ex-act/en/	"EX-ACT provides its users a consistent way of estimating and tracking the outcomes of agricultural interventions on GHG emissions." It also allows farmers to explore different mitigation opportunities.	Excel	✓		
Fieldprint	https://fieldtomarket.org/our-programs/fieldprint-platform/	"Fieldprint helps to measure the environmental impacts of commodity crop production and identify opportunities for continuous improvement." It helps farmers look at a wide range of environmental impacts and can integrate scenario planning, but focuses only on select crops.	Website	✓	✓	✓
SMART	http://www.smart-farmtool.com/	"SMART is a method that allows farms and companies in the food sector to assess their sustainability in a credible, transparent and comparable manner."	Application for expert users	✓	✓	✓
SISC	https://www.stewardshipindex.org/sisc-stewardship-calculator	"The Stewardship Calculator empowers growers, packer-shippers, processors, grower groups, brands, and retailers at every stage in their sustainability journey to baseline the environmental impacts of fruit, nut, or vegetable production, then identify and track opportunities for continuous improvement."	?	✓	✓	✓

For those tools that can accommodate a wide range of specialty crops and were farmer focused, we also assessed the scope of tool and whether critical farm actions that strongly influence the environmental footprint were included. Table 2E shows the results.

TABLE 2E: CHARACTERISTICS OF FOUR FARM-FOCUSED TOOLS

	COMET-FARM	COOL-FARM	EX-ACT	SISC
Scope and approach				
Cradle-to-gate?		✓	✓	✓*
Annuals and perennials?	✓	✓	✓	✓
Approx. no. of questions	30+	54+	14+	variable
All US geographies?	✓	✓	✓	✓**
Are all select specialty crops supported?	✓	✓	✓	✓**
Critical activity or management practice inclusion				
Land Use Change	✓	✓	✓	
Fertilizer Application	✓	✓	✓	✓
Other Agrochemical Applications	✓	✓	✓	✓
Tillage	✓	✓	✓	✓
Equipment	✓	✓	✓	✓
Irrigation	✓	✓	✓	✓
On-farm Waste (Unharvested)				✓
Tree Removal & Replanting	✓			✓
Pruning (Perennial Residue)	✓			✓
Residue Removal/Management	✓	✓	✓	

*Input footprints included for fertilizer only

**Soil carbon will initially be for select crops, in CA