CHOICES
The magazine of food, farm, and resource issues
A publication of AAEA Agricultural & Applied Economics Association
VOLUME 40 QUARTER 1

Diverse and (Sometimes) Divergent Needs in Maine's Wild Blueberry Industry

J.G. Malacarne, Lauren Miller, A.M. Ospina, and Bruce Wyatt

JEL Classifications: Q10, Q13, Q18
Keywords: Agribusiness, Agricultural policy, Agriculture

Global production of and demand for blueberries has grown continually over the past 2 decades (Yeh et al., 2023). This rise has been facilitated by the fact that blueberries are well adapted to many regions of the world and are produced in at least 30 countries (USDA FAS, 2021). In 2020, the United States ranked as the world's single largest blueberry producer, representing 32% of total global production (FAO, 2023). Blueberry consumption has risen rapidly in the United States as well, thanks in part to increased year-round availability of both fresh and frozen products. As of 2020, the average American consumed an estimated 2.2 pounds of fresh blueberries and 0.86 pounds of frozen/processed blueberries per year (Yeh et al., 2023).

One fascinating corner of the blueberry industry can be found in Maine, which produces nearly all of the country's lowbush wild blueberries (Vaccinium angustifolium, hereafter referred to as wild blueberries). Wild blueberries are only produced commercially in northern New England and eastern Canada and make up around 10% of domestic blueberry production (Yeh et al., 2023). The designation of wild comes from the fact that the plants are native to the region and, while managed with varying degrees of intensity, are neither planted nor undergo experimental breeding. Wild blueberries are smaller than cultivated blueberries and are known for their intense blueberry flavor. They are also touted for their contribution to healthy diets, containing antioxidant levels on par with cranberries and double that of cultivated blueberries (Haytowitz and Bhagwat, 2010).

The wild blueberry industry has both cultural and economic significance to the State of Maine. Wild blueberries were first harvested on a large scale by Wabanaki native people (Calderwood, Yarborough, and Tooley, 2020). Commercial harvest of the fruit began in the 1840s (Hanes and Waring, 2018). Today, the industry remains a focal point for Maine agriculture and tourism. Maine harvested 87.60 million pounds of wild blueberries in 2023, with 512 farms managing 46,370 acres (USDA NASS, 2024).

Traditionally dominant in the frozen processed market, wild blueberries are facing increased pressure from both domestic and imported cultivated, highbush blueberries (hereafter referred to as cultivated). From 2010 to 2023, cultivated blueberry acreage in the United States increased by 46% and production increased by 56% (USDA NASS, 2024). At the same time, the fraction of cultivated blueberry production bound for processing increased, as well, climbing from 40% in 2010 to 47% in 2022 (USDA NASS, 2024). These combined changes resulted in a 75% increase in the quantity of domestic cultivated blueberries going to processing. Sharp increases in the import of frozen blueberries, primarily from Canada and Chile, have further crowded the market for frozen blueberries (Yeh et al., 2023).

The growers navigating this landscape are also aging. The mean age of producers in Washington County, where the majority of wild blueberry production in Maine takes place, has risen from 55 years in 2002 to 60.6 in 2022, with 45.6% of producers over the age of 65 and just 2.6% were under the age of 35 (NASS, 2024). In the sample of growers providing the data discussed in the body of this article, the median age was 64.5.

In this article, we report on a survey of production practices and marketing channels among wild blueberry growers in the state of Maine. We use these data to add perspective to the industry aggregate statistics available through USDA National Agricultural Statistics Service (NASS) surveys and the Census of Agriculture. Specifically, we highlight diversity in management practices and market channels and discuss how industry participants see their primary challenges and their preparedness to meet those challenges.

We find that notably different stories emerge when weighting survey questions by the number of respondents and by area managed. The former provides

insight into the actions and concerns of individual operations and gives equal weight to each producer, regardless of operation size. The latter gives a voice to each acre of wild blueberries managed, highlighting a perspective that may prove useful in questions of industry-level land management and aggregate production. Both stories are important for supporting the future of an industry that plays such a unique role in the economic and cultural life of its state.

A Survey of Maine's Wild Blueberry Growers

In the fall of 2020, we released a survey to industry participants identified using the University of Maine Co-operative Extension database and a web search. The last such study, conducted by Rose et al. (2013), was done in spring 2010. Postcards with a link to a web survey were sent to participants. Email reminders were sent 2 weeks later and 2 rounds of phone calls were made, starting a month after the initial mailing.

In total, 571 individuals—including growers, processors, landowners, agricultural service providers, and wild blueberry researchers—were contacted. Of these, 14.5% of invitations resulted in completed surveys and 8.8% of respondents declined participation. The majority (57%) of respondents self-identified as a "wild blueberry grower." Each respondent was asked questions relevant to their self-identified roles. The distribution of responses across counties closely reflects the geographic distribution of the initial contact list.

While the number of growers responding to the survey was relatively small, the area of land managed by respondents was significant. Respondents report managing just under 14,000 acres of land in a typical year and harvesting just over 7,000 acres. For perspective, NASS reports that between 2018 and 2020, an average of 20,000 acres of wild blueberries were harvested in Maine. Our survey respondents, then, represent 35% of the wild blueberry acreage harvested in the state.

In what follows, we will call attention to the heterogeneous nature of wild blueberry operations. The area managed for wild blueberry production is a good place to begin this discussion. While the median grower respondent reports managing 32 acres, the mean of acres managed was 292, with the full range running from fewer than 5 acres to over 5,000 acres. Unsurprisingly, the practices and concerns of growers of different scales are not always in line with one another. Below, we compare and contrast views of the industry when giving a voice to each acre and to each respondent. We believe that both perspectives are valuable, particularly where they tell different stories. For example, respondent-weighted perspectives shed light on how programs and policies are likely to be received by the industry. Acre-weighted perspectives, on the other hand, may provide a clearer picture of how behavior changes induced by economic, environmental, or policy changes are likely to be reflected in land use and market outcomes.

Through our analysis, we document the following stylized facts:

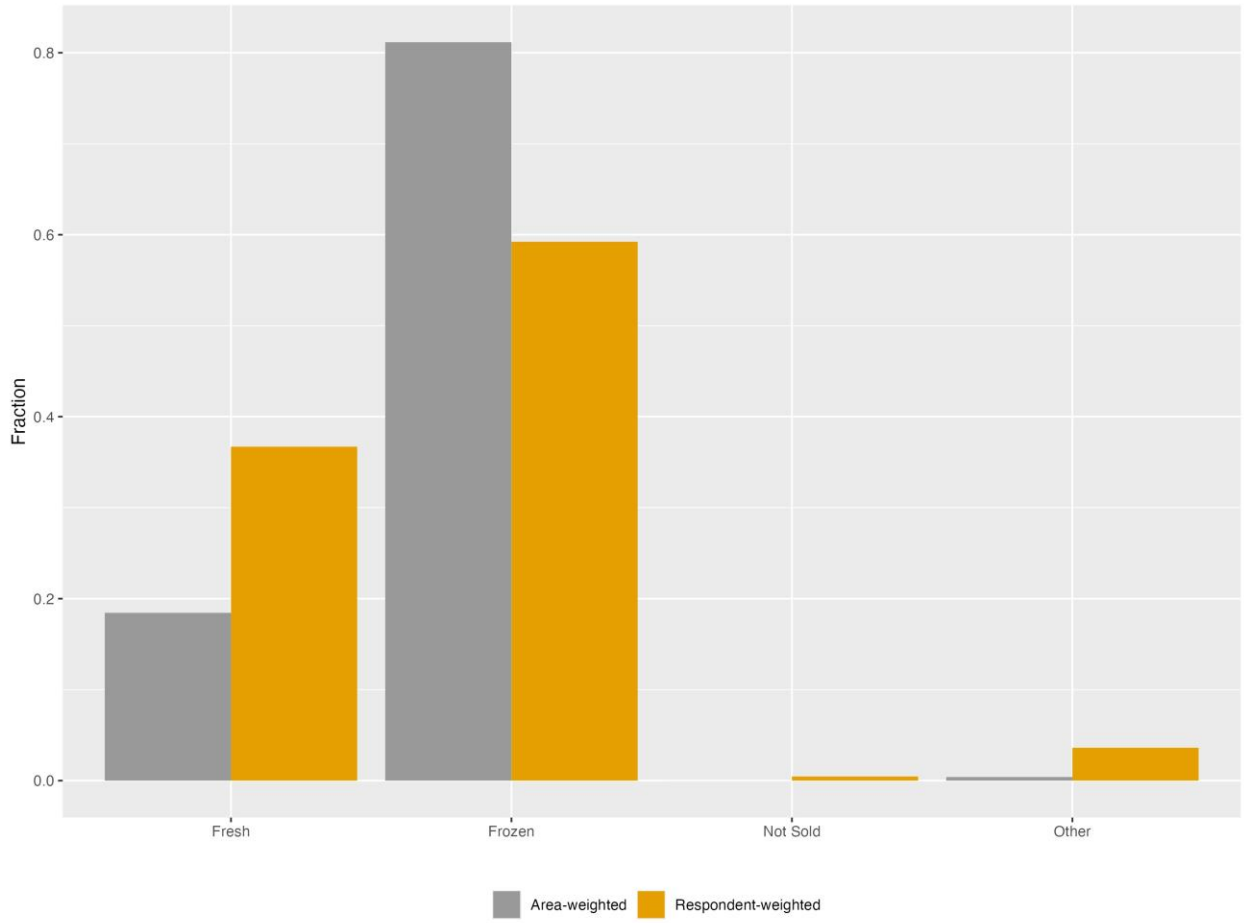
1. Growers sell into a wide and expanding variety of market channels, but most wild blueberry acres still produce for the frozen market.
2. Dominant practices differ significantly when the data are weighted by acres and by respondents. Notably, relatively few acres are managed under organic practices, but a significant fraction of growers report using organic practices.
3. Farm profitability and climate risk are pressing concerns under both weighting schemes. Responses indicate that the industry feels well prepared to deal with profitability concerns but not with climate concerns.
4. While most wild blueberry acres are expected to be in production 5 and 10 years in the future, a substantial share of respondents are less certain. While respondents would overwhelmingly like to see their land stay in production, few have explicit plans for farm transition.

Growers Sell in a Variety of Channels, Acres Still Go Primarily to the Frozen Market

As noted in Yeh et al. (2023), the majority of wild blueberries are bound for the processing market. Historically, wild blueberries have dominated the processed market. However, this segment has faced increasing pressure as expansion in highbush (cultivated) blueberry production worldwide has forced highbush blueberries into the frozen market.

Our data highlight notable heterogeneity in this story. Weighted by area, 81% of wild blueberries in our sample are reportedly sold as frozen versus only 59% when weighted by respondents (Figure 1). A significant share of wild blueberries in the sample are also sold fresh, nearly 40% when weighting by respondents, with a negligible amount going to value-added products. This diversity is present in sales channels, as well. While the majority of respondents report selling wild blueberries to processors, nontrivial fractions of respondents also sell directly to consumers (42%) and to businesses (40%). Respondents report that the relative importance of these market channels had remained mostly unchanged over the past 5 years, suggesting that, for many growers, this more diversified marketing approach is not a new phenomenon.

Figure 1: Type of Product Sold in 2019



Within the direct-to-consumer sales channel, wild blueberry growers reported making use of farm stands (45%), farmers' markets (40%), and websites (35%). Respondents selling directly to businesses mention selling to restaurants (32%) and winemakers (26%), while fewer respondents mentioned selling to bakeries (16%) and breweries (16%).

One contributing factor to this story is likely the differing role that wild blueberry production plays in the overall income-generating portfolio of smaller and larger operations. The median respondent in the data earns 20% of their income from wild blueberry sales, up from the 15% reported by Rose et al. (2013) in 2010. However, a significant set of respondents earn little income from wild blueberries, while others earn all or most of their income from wild blueberries. Likewise, only 30% of respondents report growing blueberries as a full-time occupation, and 57% of respondents report being paid for off-farm work in the past year. When weighted by area, the split is even more stark, with nearly all acres managed either by an operation that derives less than a quarter of its income from the sale of blueberries or an operation deriving almost all its income from wild blueberries.

Similarities and Differences in Management Practices

Wild blueberry production follows a 2-year cycle, with half of managed area typically harvested in any given year. After harvest, wild blueberry plants are mowed to the ground or burned using oil or straw to control pests and disease and to promote vegetative growth in the above-ground portion of the plant. Plants then spend a full year growing new vegetation before they are once again ready to produce fruit (Calderwood, Yarborough, and Tooley, 2020). In this section, we focus on four aspects of wild blueberry management: pesticide use, irrigation, fertilization, and pruning. While growers make countless additional decisions, these broad categories provide a window into management practices in the sector.

Building on Rose et al. (2013), we asked growers to classify their pesticide management strategy using the following categories: certified organic, no spray, integrated pest management (IPM), or conventional. IPM refers to the use of biological and economic information to create a targeted strategy for dealing with pests that balances economic, environmental, and social concerns

Figure 2: Irrigation by Area and Respondent

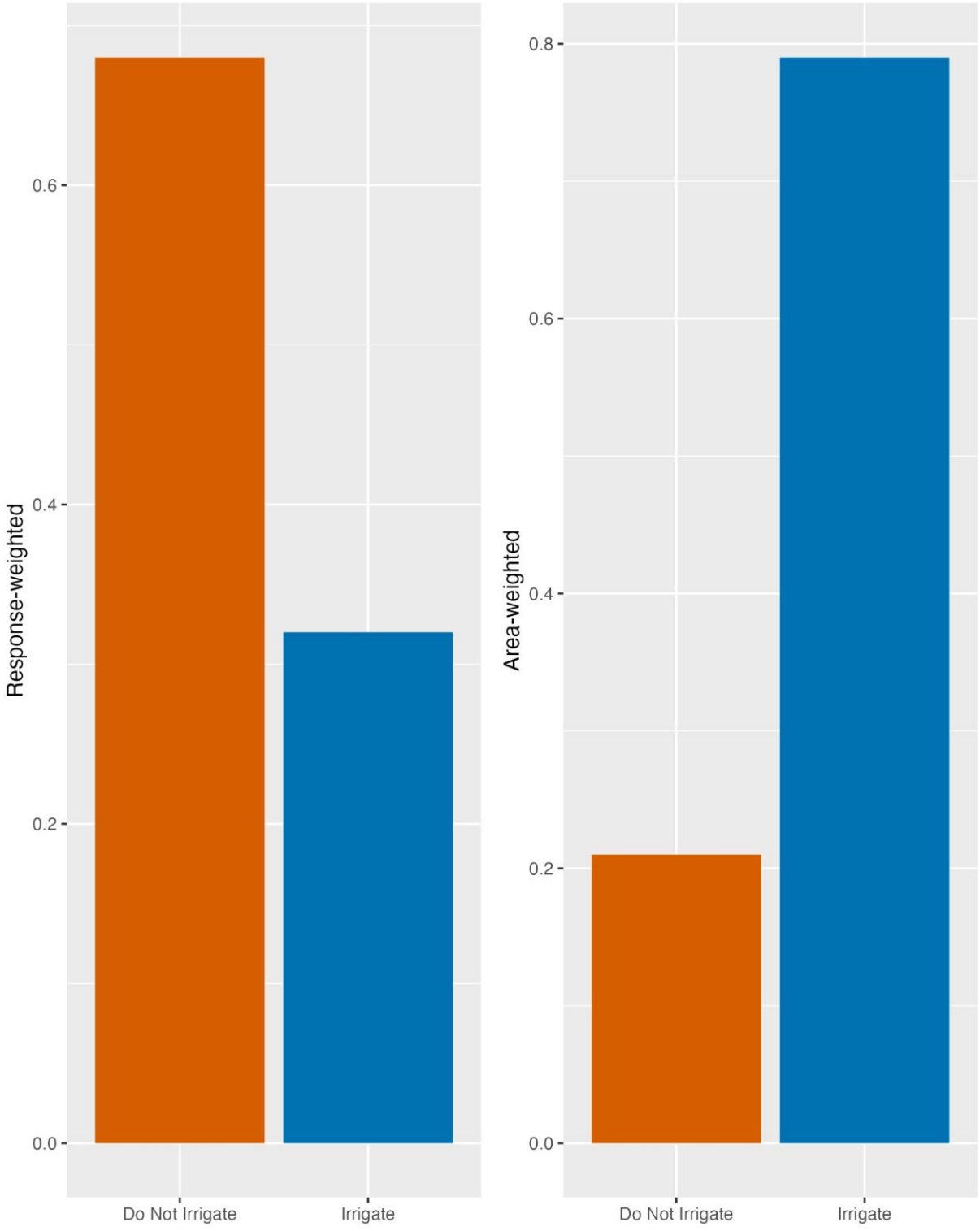


Table 1: Pesticide Management Style

By Response	Responses	Percentage
Certified organic	16	33.33 %
No spray	4	8.33 %
IPM	19	39.58 %
Conventional	8	16.67 %
No response	1	2.08 %
Total	48	100 %

By Area	Acres Managed	Percentage
Certified organic	1,038.77	7.42 %
No spray	231.00	1.65 %
IPM	11,906.00	85.07 %
Conventional	785.00	5.61 %
No response	35.00	0.25 %
Total	13,995.77	100 %

(University of Maine, 2019). Rose et al. (2013) reported IPM as the most common management practice in 2010; 10 years later, its popularity continues. Weighted by area, 85% of reported acres are managed by a grower identifying IPM as their pesticide management strategy. This corresponds to 40% of respondents.

One of the starkest differences that emerges from our two weighting schemes comes in relation to organic management. Organic management of wild blueberries has been growing. According to NASS data, there were 58 organic wild blueberry operations in 2021, harvesting 1,342 acres. This represents a 25% increase in operations and a 338% increase in acreage since 2014. In our survey, 33% of growers and 7% of acres harvested report organic production, a significantly larger portion than what NASS reports. The 16 organic growers present in our data harvest 503 acres, meaning they constitute 28% of the state's organic certified growers and manage 37% of the state's organically managed wild blueberry acres. In comparison, the full set of grower respondents constitute about 10% of total wild blueberry operations and 35% of total wild blueberry acres.

There are two implications here. First, the acre-weighted average is more representative of wild blueberry production in the state than the respondent-weighted average, at least in terms of practices. Second, the survey was quite effective in reaching organic producers. As such, the responses collected from organic producers likely represent this segment of the industry relatively well. Where the respondent- and area-weighted stories differ, it is likely that diverse and possibly divergent needs exist across different groups in the industry.

One topic on which the area- and respondent-weighted stories differ is irrigation. While northeastern states, including Maine, have not traditionally relied heavily on irrigation, drought events in 2016, 2020, and 2022 significantly affected yields among small fruit growers and spurred greater interest in water management (Schattman, Goosen and Calderwood, 2021; Sweet et al., 2017). In a survey of Northeast farmers, including wild blueberry growers, Schattman et al. (2024) find strong interest for additional information, technical assistance, and financial assistance related to water management—both in terms of source development and irrigation as well as excess water management. While only 32% of respondents to our survey report using irrigation, 79% of surveyed acres are managed by a respondent that irrigates at least some of their acreage.

Not all practices differ so starkly under the two weighting schemes. Nearly all respondents report nutrient management through use of fertilizers. Under both weighting schemes, fertilizing every prune year or in response to foliar tests were the most common. Weighted by respondents, 44% of respondents use foliar tests to determine when to apply fertilizer and 44% of respondents fertilize every prune year; 30% of respondents also report soil testing. Weighted by area, fertilizing every prune year was the dominant method (68%), followed by foliar testing (32 %), with only 7% of acres reporting soil testing.

As noted above, wild blueberry land is typically managed on a 2-year cycle consisting of a "prune" year and a harvest year. The majority of respondents by area and number report both mowing and burning as prune methods, continuing the trend from 2010 (Rose et al. 2013). Weighted by area, mowing and burning with oil (65%) is most common prune method, with burning occurring every other year (88%). Methods and timing vary more when weighting by respondents. Most notably, significant fractions of respondents report only

mowing (41%) or mowing and burning with straw (24%). Burn frequency is also lower when weighting by respondents, with 48% reporting burning every 4 or more years and 33% burning every other year. The differences in prune method across the two weighting schemes are likely a result of scale, as respondent weighting emphasizes practices prevalent among the larger number of smaller farmers, where straw burning is more feasible and emphasizes labor over machinery. Similar dynamics can be seen in the use of mulch, which can be used to reduce water loss, control soil temperature, control weeds and disease, and stimulate growth (Gumbrewicz and Calderwood, 2022). Under both weighting schemes, use of mulch is extremely common. Weighting by area, however, spot mulching is dominant (90%) with little whole-field mulching (1%). Weighting by respondent, whole-field mulching rises to 10% and spot mulching falls to 68%.

Finally, grower respondents uniformly rely on bees to pollinate their wild blueberries, with around 80% of respondents renting or buying bees. While 25% of respondents (15% of acres) report renting both honeybees and bumblebees, rental of honeybees is dominant, although Rose et al. (2013) note that these are less efficient than native bees.

Across the practices considered, area-weighting paints a picture of a more input-intensive sector than does respondent-weighting. This trend was visible both in irrigation, which has implications for how the sector deals with drought and frost events, and in pruning and input application. The sector appears more vulnerable to weather risk through the respondent-weighting lens, which may highlight a lack of scale appropriate and financially accessible mitigation options for smaller growers. At the same time, the area-weighted lens suggests that the sector may be able to sustain output in the face of adverse weather conditions, even as those conditions affect numerous individual operations.

Concerns and Preparedness

The management and marketing strategies discussed thus far are, in part, chosen to deal with the risks faced by wild blueberry growers. Different management strategies imply different challenges for dealing with pests and diseases, though the respondent-weighted and area-weighted results generally agree on the most common challenges. For example, the blueberry maggot fly (Rhagoletis mendax; see Rodriguez-Saona et al., 2015, for more information) was reported as the most common pest under both weighting schemes. However, future concerns focus primarily on spotted wing drosophila (Drosophila suzukii; see Yeh et al., 2020, and Tait et al., 2021, for more information), a more recent invasive pest. The story is similar regarding disease pressures, where mummy berry disease (Monilinia vaccinii-corymbosi, see Ashley and Annis, 2024, for more information) is identified as the most common and, into the future, most pressing.

To understand grower views on challenges that impact the future of the industry broadly, we asked about the extent to which respondents are concerned about the profitability of their farms, the impact of climate change on their farming operation, and their mental and physical health. We followed up by asking how prepared they feel to meet each of these challenges. The results are reported in Table 2. While respondents express some level of concern for all risk categories, they feel equipped to deal with these challenges to very different extents.

Consistent with the findings of Rose et al. (2013), making a profit remains respondents' primary concern. Despite 91% of respondents being somewhat or very concerned about the profitability of their farming operation, 79% feel that they have access to adequate resources to deal with this concern. In contrast, 79% report being somewhat or very concerned about the impacts of climate change on their farming operation, but only 51% feel that they have access to adequate

Table 2: Grower Concerns and Resource Adequacy

By Response	Not Concerned	Somewhat Concerned	Very Concerned	Adequately Resourced	Not Adequately Resourced
Profitability	0.09	0.27	0.64	0.79	0.21
Climate	0.18	0.36	0.47	0.51	0.49
Physical Health	0.23	0.50	0.27	0.79	0.21
Mental Health	0.52	0.39	0.09	0.90	0.10
By Area	**Not Concerned**	**Somewhat Concerned**	**Very Concerned**	**Adequately Resourced**	**Not Adequately Resourced**
Profitability	0.05	0.12	0.83	0.90	0.10
Climate	0.21	0.23	0.56	0.31	0.69
Physical Health	0.15	0.75	0.10	0.81	0.19
Mental Health	0.36	0.61	0.03	0.84	0.16

resources to address this concern. The same pattern is visible when weighting by area: 95% of area-weighted responses are somewhat or very concerned about farm profitability, but 90% report that they are adequately prepared to deal with this challenge. With regard to climate risks, 79% are somewhat or very concerned, but only 31% feel they have adequate resources to meet the challenge.

Conclusions

Like many agricultural sectors, the wild blueberry industry in Maine is facing changes from economic, environmental, and demographic forces. While farm profitability remains a principal concern for the industry, demand creation and flexible use of market channels seem to have left growers feeling adequately resourced to meet the economic challenges in front of them.

Environmental and demographic challenges may pose more of a problem, particularly as they affect different groups of producers differently. Growers feel exposed to significant climate risk, and many feel they are not adequately resourced to meet the challenge. Our summary of irrigation use suggests that scale appropriate and economically feasible technology for mitigating weather risk, including drought and frost, may not currently be available to many smaller growers.

Changing climate conditions have implications for pest and disease pressure as well. While both the area- and respondent-weighted data show IPM to be the dominant strategy for approaching these challenges, certified organic and no spray growers have fewer options to respond to a rise in pest and disease pressure. Robust monitoring and efficient information dissemination can help growers tailor mitigation efforts to their chosen management style.

Mitigating climate hazards requires long-term planning and investment, which may not be seen as feasible by aging operators. While area-weighted responses indicate that the majority of wild blueberry acres are expected to remain in production 5 and 10 years into the future, the respondent-weighted data suggests that many growers are less sure. More than 30% of grower respondents report that they may or definitely will not be growing wild blueberries in the next 5 years, and 45% may not be growing wild blueberries in 10 years. While respondents overwhelmingly hope to see their land stay in blueberry production, only half of respondents report having an explicit plan for their land when they retire. Support for transition planning exists through a variety of agricultural service providers in the State of Maine, which suggests that barriers may exist to accessing these resources or growers may not view the existing resource as well suited to their needs.

The diversity in practices, concerns, and self-perceived preparedness documented in this article suggest that there are likely to be few one-size-fits-all solutions for supporting wild blueberry growers, even where there is agreement on the broad challenges and specific hazards facing the industry. Quite simply, when there is no single, unified need there can be no single, unified solution. As such, acknowledging the varied needs in the industry and the importance of individualized support programs is a step forward as policy makers, agricultural advisors, and industry professionals consider how to deploy limited resources to build a strong future for this unique industry.

For More Information

Ashley, K.A., and S.L. Annis. 2024. “Population Structure and Reproductive Biology of *Monilinia vaccinii-corymbosi* in *Vaccinium angustifolium* in Maine.” *Plant Disease* 108(1):182–189.

Calderwood, L., D.E. Yarborough, and B. Tooley. 2020. “About the Maine Wild Blueberry.” University of Maine Cooperative Extension. Available online: https://extension.umaine.edu/blueberries/about/

Food and Agriculture Organization of the United Nations (FAO). 2023. *FAOSTAT Statistical Database.* Available online at https://www.fao.org/faostat/

Gumbrewicz, R., and L. Calderwood. 2022. “Comparison of Wood Mulch Particle Sizes for Wild Blueberry Management in a Changing Climate.” *International Journal of Fruit Science* 22(1):551–567.

Hanes, S.P., and T.M. Waring. 2018. “Cultural Evolution and US Agricultural Institutions: A Historical Case Study of Maine’s Blueberry Industry.” *Sustainability Science* 13:49–58.

Haytowitz, D.B., and S. Bhagwat. 2010. “USDA Database for the Oxygen Radical Absorbance Capacity (ORAC) of Selected Foods, Release 2.” *US Department of Agriculture* 3(1):10–48.

Rodriguez-Saona, C., C. Vincent, D. Polk, and F.A Drummond. 2015. “A Review of the Blueberry Maggot Fly (Diptera: Tephritidae).” *Journal of Integrated Pest Management* 6(1):11.

Rose, A., F.A. Drummond, D.E. Yarborough, and E. Asare. 2013. *Maine Wild Blueberry Growers: A 2010 Economic and Sociological Analysis of a Traditional Downeast Crop in Transition*. Maine Agricultural & Forest Experiment Station Miscellaneous Report 445.

Schattman, R.E., C.P. Goosen, and L. Calderwood. 2021. *The 2020 Maine Drought and Agriculture Report*. University of Maine. Available online: https://umaine.edu/climate-ag/2021/04/29/2020-maine-drought-and-agriculture-report/

Schattman, R.E., J.G. Malacarne, E. Mallory, and C.P. Goossen. 2024. “Supporting Farmers in Coping with Water Extremes: Aligning Farmer Needs and Advisor Confidence, Skills, and Expertise.” *Environmental Research: Food Systems* 1(2):025002.

Sweet, S.K., D.W. Wolfe, A. DeGaetano, and R. Benner. 2017. “Anatomy of the 2016 Drought in the Northeastern United States: Implications for Agriculture and Water Resources in Humid Climates.” *Agricultural and Forest Meteorology* 247:571–581.

Tait, G., S. Mermer, D. Stockton, J. Lee, S. Avosani, A. Abrieux, G. Anfora, E. Beers, A. Biondi, A. Burrack, et al. 2021. “*Drosophila suzukii* (Diptera: Drosophilidae): A Decade of Research Towards a Sustainable Integrated Pest Management Program.” *Journal of Economic Entomology* 114(5):1950–1974.

University of Maine. 2019. *What is IPM?* University of Maine Cooperative Extension: Insect Pests, Ticks and Plant Diseases. https://extension.umaine.edu/ipm/what-is-ipm/

U.S. Department of Agriculture Foreign Agricultural Service (USDA FAS). 2021. “Blueberries Around the Globe – Past, Present, and Future.” *International Agricultural Trade Report* Available online: https://www.fas.usda.gov/data/blueberries-around-globe-past-present-and-future

U.S. Department of Agriculture National Agricultural Statistics Service (USDA NASS). 2024. “Quick Stats Database.” Available online: https://quickstats.nass.usda.gov/

Yeh, D.A., F.A. Drummond, M.I. Gómez, and X. Fan. 2020. “The Economic Impacts and Management of Spotted Wing Drosophila (*Drosophila suzukii*): The Case of Wild Blueberries in Maine.” *Journal of Economic Entomology* 113(3):1262–1269.

Yeh, D.A., J. Kramer, L. Calvin, and C. Weber. 2023. “The Changing Landscape of US Strawberry and Blueberry Markets: Production, Trade, and Challenges from 2000 to 2020.” USDA Economic Research Service, Economic Information Bulletin EIB-257, September.

About the Authors: J.G. Malacarne (jonathan.malacarne@maine.edu) is an Assistant Professor of Agricultural Economics with the School of Economics at the University of Maine. Lauren Miller (Lauren.Miller2@usda.gov) is an Agricultural Economist with the Food Economics Division at USDA – Economic Research Service. A.M. Ospina (aospinatobar@umass.edu) is a Graduate Student with the Department of Resource Economics at the University of Massachusetts. Bruce Wyatt (bruce.wyatt@maine.edu) is a Graduate Student with the School of Economics at the University of Maine.

Acknowledgments: J.G. Malacarne acknowledges support through the USDA National Institute of Food and Agriculture, Hatch project #ME022325 through the Maine Agricultural and Forest Experiment Station. Data were collected while Lauren Miller was at the University of Maine, prior to joining USDA ERS. The findings and conclusions in this publication are those of the authors and should not be construed to represent any official USDA or U.S. Government determination or policy. Data collection for this work was supported by the Maine Wild Blueberry Advisory Committee Project P0590—“State of Maine Wild Blueberry Industry Survey.” All views expressed are those of the authors and do not reflect the beliefs or opinions of the Maine Wild Blueberry Advisory Committee.