

Conservation in a Changing Climate

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Executive Summary

Our team has been granted the opportunity to work with the Michigan Department of Agriculture and Rural Development (MDARD) to help assess the impacts of climate change on agriculture in the state, and particularly what it means for the importance of land preservation efforts by the department. Our goal in this project is to be able to provide both MDARD and local farmers with resources they can use to help navigate a changing climate to prevent any deterioration of the local agricultural sector which is vital to the economic and social development of the state.

Part of MDARD's purpose is to help conserve Michigan land for agricultural purposes in the future. The Michigan Agricultural Preservation Fund allows for the purchase of permanent conservation easements on farmland. With such an easement, land is permanently required to be used for agricultural purposes. While the department has tried to push for the growth of this program, easements are currently concentrated largely in southeastern counties, and almost nonexistent in many parts of northern Michigan. This is due largely to a lack of funding for outreach to explain the easements and a multi-step application process, which requires cooperation and support from local governments. In addition, the financial benefits that may come from selling land to private developers are intriguing to many landowners, especially in the face of crop growth uncertainties with unpredictable weather patterns. Our team has been working to better understand these complications, the areas most in need of outreach, and the key struggles of agricultural land owners in order to build transparency and positive communication between MDARD and the farming community.

Our project consisted of three phases: stakeholder engagement, survey development and distribution, and solar energy research. We first visited and interviewed farmers who had conservation easements to better understand the process of acquiring one. During these conversations, we also discussed a wide range of topics such as climate change, the relationship between MDARD and Michigan farmers, and the use of solar energy on farmland. Additionally, our team has attended seminars led by the Michigan Environmental Council on climate change and conservation to further our understanding and hear additional perspectives on our research topic. With a better understanding of our project scope, we began to develop our survey which included questions about farmers' crop output, their views on changing weather patterns and how they have seen them affect their crops, and what they would most like to see from MDARD to help support their success. In the last stage of our project, after seeing stakeholder interest in the topic, we studied the issue of solar development on agricultural land. We developed an informational pamphlet on Canva that could be used to communicate information about small-scale solar on agricultural land for Michigan farmers in the conservation easement program.

We hope this project will encourage land conservation in Michigan by building a stronger understanding between MDARD and the communities they serve. In addition, we hope this project will expand the scope of what is possible on conservation land and improve community understanding of sustainable land use.

Introduction and Background

The Farmland Conservation Program through the Michigan Department of Agriculture allows farmers to pass development rights to other farmers, ensuring their land stays in agricultural production. While the Department of Agriculture owns these rights, farmers are still allowed to farm their land and build in designated building areas. This is an important option for many farmers as the ability to generationally pass down farmland becomes more difficult. Farmland in the United States, and Michigan in particular, is undergoing a rapid transformation of being converted into commercial and residential land. For farmers and food producers, keeping farmland in production is essential to Michigan and the Midwest's farming tradition.

In terms of conservation, soil is one of the most essential and fickle elements of farming. Soil does regenerate, however, this process of regeneration is in the order of thousands of years (Appendix D). In the early days of farming by European settlers, the organic matter and fertility of the soil was ransacked by farming practices that included clearing native vegetation, monocrops, and intense tillage. While the Midwest and Michigan have some of the most productive soils in the world for farmland, this may not always be the case if management practices deplete resources in a matter of hundreds of years.

By keeping land in agricultural production, farmers may be more inclined to preserve their soil and productivity if it is understood that this land will have to provide food, fuel, and fiber for innumerable generations in the future. The land conservation program is inextricably connected to soil and land conservation. This notion is echoed by the many other conservation projects that are ongoing in Southeast Michigan, such as the Ann Arbor Greenbelt (Appendix D).

Climate change is another factor influencing how Michigan farmers use their land. Through changing conditions, they may be forced to alter what crops they grow, when they harvest and plant, and even large changes in the regional food system as a whole (Appendix D). This is another way in which farmers may realize that in order to keep land in production—as is stated in the land conservation plan—they must make changes to the farming system.

There are other land use changes associated with climate change other than management practices such as the increase in land used for green energy production. By way of state and federal incentives, farmers in Michigan are seeing their land bought up by large solar installations from utility companies. Many farmers who are struggling may see the buyout from utilities as a way to stay afloat, even though it may mean giving up on farming and turning the land into a solar array. The land conservation program tries to combat this by providing tax breaks for farmers while still making sure that land stays in production and also in the hands of the farmers themselves.

This battle between solar developers and farmers is tricky because green energy is necessary for mitigating the impacts of climate change, but sustainable and thoughtful agricultural production is also essential to providing resources for a growing population. The land conservation program through MDARD could be a way to straddle between these two groups and promote small-scale solar, owned by the farmers and used on their property, while also keeping land in production and making farmers think about how to keep land fertile for the next generations.

Methods

Topic 1: Stakeholder Conversations

We identified the main stakeholders in our project to be our partner, MDARD, and Michigan farmers/conservation land owners. To better understand the relationship between these various stakeholder needs, we organized in-person visits to Michigan farms that were under conservation easements. Our MDARD contact, Elizabeth, initially set up the relationship between some of her clients and our team. We chose clients who represented a wide range of situations from a typical easement land case to an all-organic, self-sustaining energy conservation land (Appendix A, Photo 1). For each visit, we developed potential questions to ask the owners with the goal of using these responses to inform our project recommendations and survey scope. During each of these meetings we learned more about the processes of obtaining conservation easements, the land owner's motivations, and particularly focused on how their land use challenges related to climate change. We also used these meetings as an opportunity to broaden our network in the space of agricultural land conservation.

Topic 2: Survey Development

We developed a survey to better understand farmers' motivation behind pursuing conservation easements, as well as their attitudes towards climate change. Informed with the insight from our conservation land site visits, we brainstormed the survey questions and reviewed them with our project lead, Elizabeth. We went back and forth editing the survey to make sure it addressed both the climate and sustainability questions as well as questions related to farmer attitudes towards MDARD that would help MDARD better serve the community. The final survey consisted of 21 questions covering key areas such as, farm location and size, demographics, crop types, motivations for pursuing an easement, and climate effects on farmland. We used a variety of multiple choice and short answer questions, in order to give farmers the ability to fully express their thoughts, while still being able to organize the data collected by different categories. We consulted with a survey expert from the Survey Research Center at the University of Michigan Institute of Social Research, Margaret Hudson. Once we finalized our questions we used the online tool, Qualtrics, to create the survey (Appendix B). Participants were recruited through our contact at MDARD who gave us contact information for over 100 conservation easement participants in Michigan. We first sent out the survey via email December 2nd, 2022, and then decided to expand our outreach through mailed surveys to cater to those with limited internet access, we uploaded mailed surveys as PDFs and manually entered the responses into Qualtrics. By October 2023, we received a total of 24 responses from across the state (Appendix B). We then used Excel and R to analyze various relationships in the survey data.

Map of Survey Respondent Locations

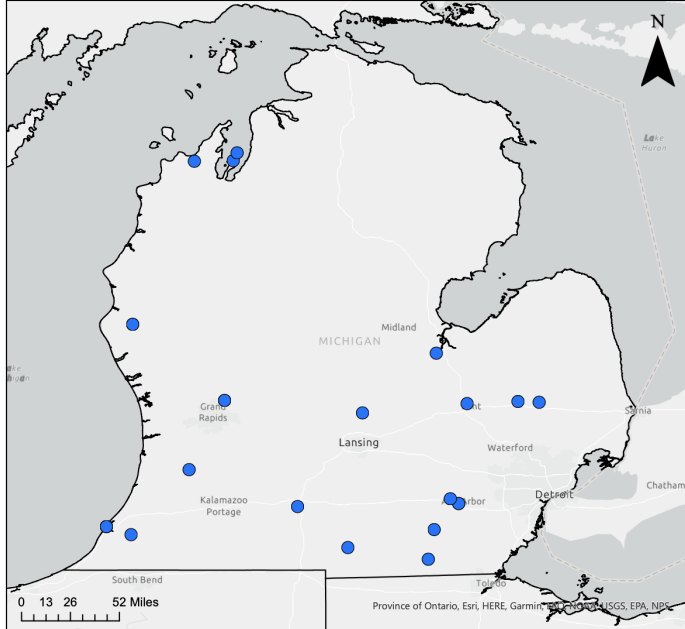


Figure 1: Map of survey respondent farm land locations. Our respondents were mostly located throughout southern Michigan, although a few were also from the Traverse City area.

Topic 3: Researching Solar on Agricultural Land

During our land visits as well as in the survey responses, we noticed an interest in solar development on agricultural land. Personal solar development is of interest to MDARD because it is an alternative to selling land for commercial solar development, a process that limits the conservation easement program. Because of this, our team focused part of our project on researching solar applications on agricultural lands. This included a literature review, conversations with landowners who currently have solar projects on their properties (Appendix A, Photo 2), meeting with experts like Ken Zebarah of Harvest Solar, and attending the Michigan Solar Conference in May of 2023. After completing this research, we began to develop an informational pamphlet on Canva that could be used to communicate information about small-scale solar on agricultural land (Appendix C).

Deliverables and Recommendations

Survey Results

Our survey showed a wide range of opinions from the agricultural community regarding their opinions on weather and climate change as well as their relationship to MDARD. We sent our survey to a total of 94 landowners, 60 by email and 34 by mail. We had a response rate of 25% and the majority of our respondents were white men over the age of 40, who had farms that were between 100 and 300 acres or between 600 and 100 acres. The majority of farmers surveyed grow mainly corn, wheat, and soy.

The first set of questions we were interested in exploring in this data set related to

farmers' perceptions of climate change and its impact on their land. When asked if they have noticed long-term weather changes over the last 10 years, 65.22% of respondents answered "yes". When analyzing the relationship between long-term weather changes and their impact on crops, we see that most respondents who have generally noticed long-term weather changes (65%) have also seen their crop output impacted (Figure 1). We also see that 34% of respondents who have not noticed long-term weather changes have still seen some impact on their crop performance. We determined that the majority of farmers who grew fruits and vegetables reported that they have considered changing their crop type due to changing weather conditions. Conversely, those growing grains were much less likely to consider potentially changing their crop production (Figure 2). This demonstrates a key finding that certain crops are much more vulnerable to a changing climate, and therefore such farms need to be prioritized in MDARD's outreach efforts.

Additionally, through this survey, we were very interested in developing a better understanding of MDARD's relationship with farmers. When asked if they felt supported by the department 36% of farmers reported feeling "neutral" and 54.5% of farmers responded either "somewhat yes" or "definitely yes". The majority of respondents (60%) stated that they were not interested in receiving information on crop management from MDARD, however, we found that respondents who reported having considered changing their crops due to weather pattern changes were more likely to be interested in receiving materials from MDARD. In our survey, we also offered farmers an opportunity to provide open-ended responses to what support they would like to receive from the department and received a wide range of responses. Some of these responses include requests for more information about grant programs, forest management, and farm-specific assistance dealing with issues such as preserving their lake from lowering water tables. We also received concerns from farmers about issues including restrictive local zoning laws and the purchase of productive farmland for large-scale solar development. Lastly, an equal amount of respondents reported preferring to receive information from the department through email as compared to physical mail. This portion of the survey provided insight into the opportunities for MDARD to expand its outreach efforts and better support Michigan farmers.

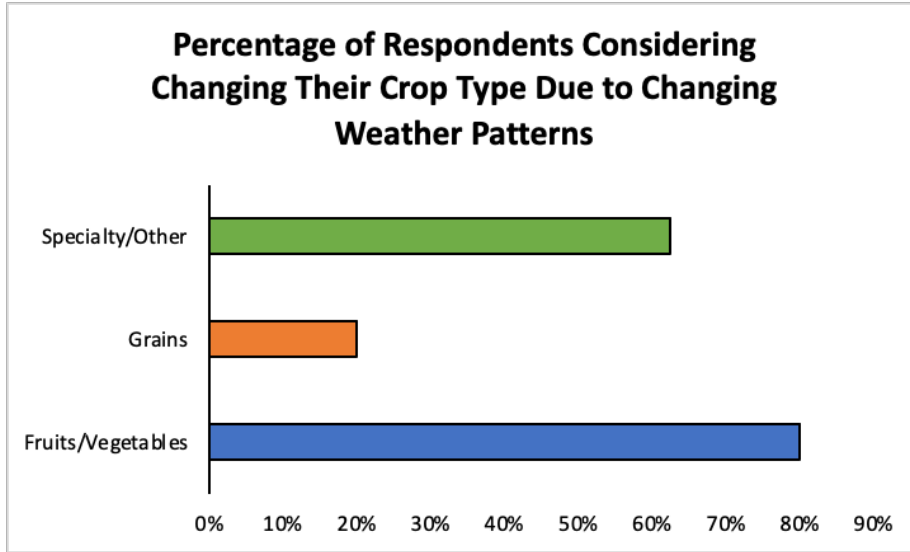


Figure 2: Separated by crop type, we see that Fruits and vegetables are the crop type respondents feel is most vulnerable to changing weather, followed by specialty crops. Grains like wheat are perceived as less vulnerable.

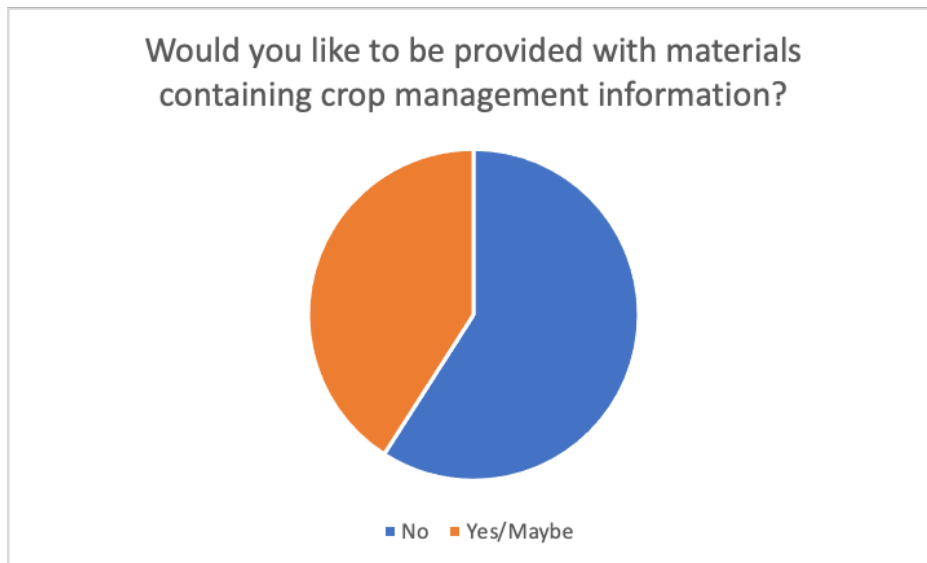


Figure 3: Most respondents would not like to be provided with materials on crop management, but there is a significant population that would appreciate this type of support from MDARD.

Solar Pamphlet Formulation:

Our decision to research solar on conservation land developed out of stakeholder interest seen both in person and in survey responses. There were some farmers with the capital to invest in small-scale solar, but more often than not we found interested parties were frightened by the upfront cost. To get a better idea of the processes and costs Michigan farmers would face, we started by meeting with a variety of professionals in the field, such as Rosie Pahl

Donaldson from the Greenbelt Program, a local solar advocate who prefers to stay unnamed, and Ken Zabarah from Harvest Solar.

After recognizing the interest in solar, we learned about the land-based ranking system incorporated with grants or loans. Rosie, from the Greenbelt Program, also got us started with the restrictions that apply to easement holders with solar, such as not being able to sell power generated back to the main grid system. We also met with a local activist who emphasized the importance of stability and trust within a community. He advocated for boots-on-the-ground methods, a timely yet effective approach. He helped us better communicate with farmers and directed us to stress the importance of solar's investment on the soil and land.

With a stronger foundation, we moved on to our final stages of developing an informative solar pamphlet. This began when meeting with Joel Tatum, a Midwest Solar Specialist working for the American Farmland Trust. Joel answered our questions about the barriers, education and outreach, incentives, and upkeep of solar. He connected us with Ken, the Director of Commercial Sales at Harvest Solar, a company that provides solar products and services. With this meeting, we learned about specific loan services offered such as the Rural Energy for America Program (REAP) that provides loan financing and grant funding that can increase the payback period from 5-6 to as quick as 2 years, and the 30% tax credit. We formulated all of this in our pamphlet, highlighting a general breakdown of the cost analysis including the savings on electric bills and cost per watt. Still, there was a need for further information on companies, averages, and accessibility so we were directed to the Midwest Solar Expo.

The Midwest Solar Expo is one of the biggest conferences held for solar with over 700 attendees and 80 speakers. Many voices from the solar industry are brought in, such as distributors, developers, and policy makers. We were able to attend talks by and speak with leaders in the solar industry such as Kiran Bhatraju (CEO of Arcadia Power), Chad Farrell (CEO of Encore Renewable Energy), Brad Klein (Senior Attorney of Environmental Law and Policy Center), and Michael Bloomquist (COO of Open Energy Group). Here, we heard more about the community perspective and how more vulnerable populations are disproportionately impacted by service outages. Policy and governmental action were brought into question by many speakers about how the systems can be evolved to take advantage of these new technologies. Attending this conference in person helped our team understand community excitement about solar as well as the newest developments in the industry, information that is useful for developing effective outreach materials for MDARD.

MDARD may benefit from distributing the Solar Pamphlet to both potential and current easement holders. For different reasons, farmers are turning to sell their land to the highest bidder. This is often large-scale solar companies that turn the land into limited or non-usable solar farms. Once this process begins, it starts the motion of ecological impacts such as rainfall/drainage and loss of habitat. Small-scale solar can be an incentive for farmers to keep their land while investing in cost-efficient energy. The pamphlet does not endorse any specific company, but instead offers the solution for farmers to consider. It aligns with MDARD's values to offer farmers digestible information about sustainable efforts for people a part of MDARD's community and those simply passing by.

Impact

The data that was gathered from our survey, as well as the Solar Pamphlet we produced, are both valuable resources for the Michigan Department of Agriculture and Rural Development to continue their work in supporting Michigan farmers. These deliverables have the potential to inform their outreach efforts, policy decisions, and support for Michigan's agricultural community.

Survey Results

The survey results revealed a significant number of farmers who noticed long-term weather changes in the last decade and have experienced effects on their crop outputs. This information will be critical to MDARD as it allows them to identify the vulnerability of certain crops to climate change, which can then be used to prioritize support and outreach for the most susceptible farmers. The survey results additionally indicate that a considerable number of the farmers who responded feel 'neutral' about the amount of support they receive from MDARD, which suggests room for improvement for the organization in terms of the outreach they are doing and the support they are providing.

Solar Pamphlet

The Solar Pamphlet is a resource that offers practical information about solar energy and its benefits for Michigan farmers, which MDARD can distribute to both current and potential easement holders in order to encourage them to consider implementing solar energy on their farms. The pamphlet poses an attractive alternative to selling land to large-scale solar companies, and highlights some of the grants and loans that are available to reduce the financial burden of adopting solar.

UN Sustainable Development Goals

Our work with MDARD actively contributes to several of the UN Sustainable Development Goals, such as ending hunger, ensuring access to clean energy, addressing the climate crisis, and preserving land. Our deliverables display MDARD and the Graham Sustainability Institute's commitment to aligning themselves with the Sustainable Development Goals and creating a more resilient future for Michigan's agricultural community.

Our work touches on the following Sustainable Development Goals:

SDG 2: Zero Hunger

Our survey provides insights into how the climate crisis is affecting crop production, which is an issue that directly relates to food security. By understanding the vulnerability of certain farmers and their crops to climate change, MDARD can help farmers adapt to the climate crisis, which contributes to the goal of eliminating hunger.

SDG 7: Affordable and Clean Energy

Our Solar Pamphlet encourages smaller-scale solar energy adoption, which is in turn promoting clean and sustainable energy sources. By spreading this information about solar energy to farmers, MDARD will support the effort for access to reliable and sustainable energy.

SDG 11: Sustainable Cities and Communities

Smaller-scale solar adoption can also lead to higher sustainable energy usage in rural/agricultural areas, which contributes to the broader mission of sustainable development for the entire community. The Solar Pamphlet helps raise awareness about sustainable energy options, supporting the development of more sustainable rural communities.

SDG 13: Climate Action

Our survey results highlight the impact of the climate crisis on farmers and their crops, which can contribute to a better understanding of climate adaptation. This information can inform climate action efforts, such as developing strategies to mitigate climate-related risks and enhance agricultural sustainability.

SDG 15: Life on Land

Our work for MDARD underscores the importance of the preservation of agricultural land in the face of changing weather patterns. Encouraging small-scale solar adoption can also help protect land from large-scale solar developments that could disrupt natural habitats and ecosystems.

SDG 17: Partnerships for the Goals

The collaboration with various experts and industry leaders in the development of the Solar Pamphlet demonstrates MDARD and the Graham Sustainability Institute's commitment to partnerships for achieving sustainable development. It shows that achieving these goals requires cooperation with a diverse set of stakeholders.

Acknowledgements

First and foremost, we would like to thank our contact at MDARD, Elizabeth Brost for her support throughout this project. We would also like to thank all the experts in survey development and solar energy who helped us during the course of this project, including Ken Zebarah of Harvest Solar, Rosie Pahl Donaldson of the Greenbelt Program, and Joel Tatum of American Farmland Trust. Lastly, we would like to thank Bridget Gruber and Megan McLaughlin for their support, flexibility, and guidance throughout our project.

Appendix A: Photos



Photo 1: Pictured is our project team in front of a Conservation Easement Sign at one of our farm visits. This property is an off-grid, organic, self-sustaining land protected permanently by an MDARD conservation easement.



Photo 2: Picture is a solar panel from a site visit. This property had a combination of farm preservation and open-space preservation land on the property, as well as this off-grid solar development.

Appendix B: Survey and Results

Survey: Below is our 21 question survey assessing conservation easement holder's views on farming in a changing climate as well as their relationship to MDARD.

Q1 Name (Optional)

Q2 Where is your farm located? (What county)

Q3 How large is your farm?

- Under 50 acres (1)
- 50-100 acres (2)
- 100-300 acres (3)
- 300-600 acres (4)
- 600-1000 acres (5)

Q4 Family Size

- 1-2 people (1)
- 2-4 people (2)
- 5+ people (3)

Q5 What is your highest grossing crop?

- Vegetables (1)
- Fruits (2)
- Speciality (3)
- Wheat (4)
- Other (5)

Q6 What other crops do you grow?

Q7 Have you noticed major changes in long term weather temperatures/conditions over the last ten years?

- Yes (1)
- No (2)

Q8 How much have long term weather patterns impacted your crop output?

- Not at all (1)
- Somewhat (2)
- Moderately (3)

Severely (4)

Other (please specify) (5)

Q9 Have you considered changing/have you changed the crops you produced due to changes in long term weather patterns?

Yes (2)

Maybe (3)

No (4)

Q10 Have you changed your production methods due to recent long term weather patterns?

Yes (1)

No (2)

Q11 Would you like to be provided with materials containing crop management information?

Yes (1)

Maybe (2)

No (3)

Q12 If you answered yes or maybe to the last question, what issues are you specifically interested in?

Q13 Do you feel supported by the Michigan Department of Agricultural and Rural Development?

Definitely not (1)

- Neutral (2)
- Somewhat (3)
- Definitely yes (4)

Q14 What, if anything, could the Michigan Department of Agricultural and Rural Development do to help support you?

Q15 Why did you decide to pursue an easement?

Q16 Did you use the Michigan Department of Agricultural and Rural Development website when pursuing your easement? If so, was it helpful?

Q17 How would you rate the difficulty of the easement application process?

- Extremely difficult (1)
- Somewhat difficult (2)
- Neither easy nor difficult (3)
- Somewhat easy (4)
- Extremely easy (5)

Q18 How do you like to receive information?

- In person (1)
- Through physical mail (2)
- Through email (3)
- Online (websites) (4)

Demographic Questions

Q19 Age

- Under 21 years old (1)
- 21-40 years old (2)
- 40-60 years old (3)
- Over 60 years old (4)

Q20 Gender

- Male (1)
- Female (2)
- Non-binary / third gender (3)
- Prefer not to say (4)

Q21 Race/Ethnicity

- American Indian or Alaska Native Asian (1)
- Black or African American (2)
- Hispanic or Latino (3)
- White (4)
- Two or more (5)
- Prefer not to say (6)

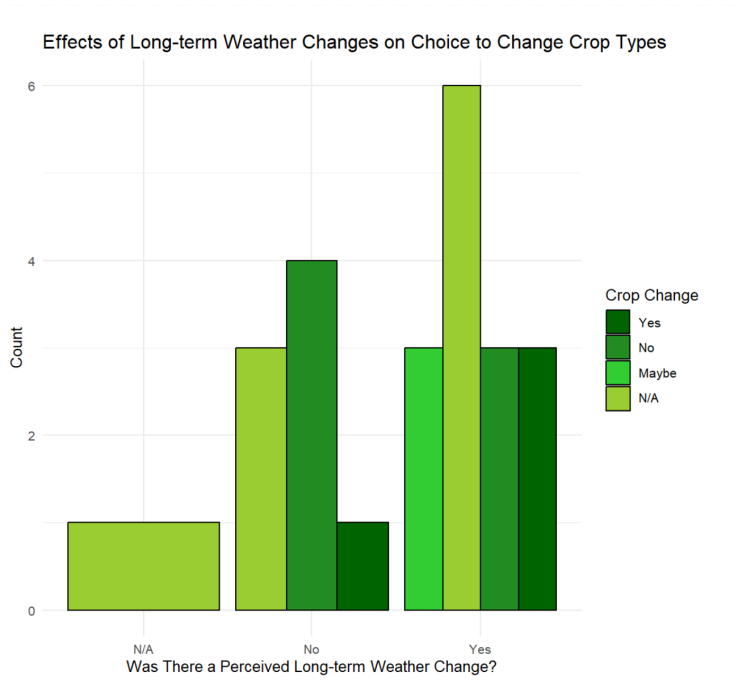


Figure 3: Most respondents have considered changing the crop they produce based on long term weather changes.

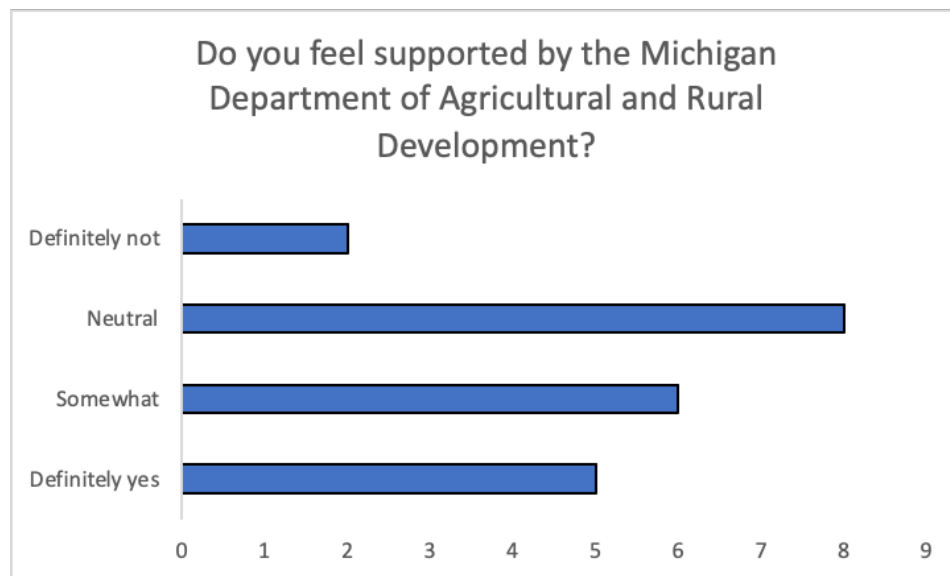


Figure 4: There is a large spread in respondents regarding how they feel supported by MDARD. Most respondents feel neutral, suggesting there is room for an improved relationship.

Appendix C: Solar Pamphlet



ENERGY TALK: ON FARM SOLAR IN MICHIGAN



Why Solar?

Solar energy is a growing industry with implementation potential on most properties. There are both economic and environmental benefits to implementing solar on your farm..

PAYBACK PERIOD

11.44 years (average)

SAVINGS

85-90% of bill (average)

COST PER WATT

\$3.50 (average)

COST ANALYSIS

- Cost of installation has decreased by 70% in recent years and is trending
- Average gross price for solar installation in Michigan is \$70,000 for a 20 kW system
- Solar costs 3 to 6 cents per kW. In comparison, fossil fuel energy costs anywhere from 5 to 17 cents per kW [click here for more info](#)

BENEFITS:

INDEPENDANCE

Implementing solar on your farm can provide energy independence from large-scale grid systems associated with power outages and high prices. Investment in solar panels can offset your farm's energy use. With solar, you own your energy.

RENEWABLE

Solar energy decreases harmful greenhouse gas emissions like carbon dioxide, helping to combat harmful climate change. Reaching 14% solar in the US by 2050 could reduce power related emissions by over 10% according to the department of energy.

TAX BREAK

There is a 30% federal tax credit for investment in solar in Michigan. This is in addition to lots of other potential grant programs available through the state.

[Click here for more info](#)

Solar & Agriculture

FAQ's

What are the rules regarding solar on properties with preserved land?

Farmland protected under PA 116 is not allowed to be sold/leased to a solar developer in most cases unless pre-approved by MDARD. However, this does not pertain to personal on-farm solar projects where power is being used as a personal grid to power the farm. In this case, solar is allowed and encouraged.

See this [link](#) to learn more about how to approve commercial solar projects on preserved land.

Are there any other incentives for farmer's to implement solar?

Yes, in addition to the tax incentive, there is the Rural Energy for America Program (REAP), which provides guaranteed loan financing and grant funding to agricultural producers and rural small businesses for renewable energy systems/energy efficiency improvements. REAP can help reduce the payback period of your solar technology to as little as two years. Check out this [link](#) to learn more!

What are the benefits of co-locating crops and solar?

Some of the benefits include reduced installation cost, reduced risk, reduced legal risk, and possible increase in PV performance as vegetation under solar modules can contribute to lower panel temperatures and increased performance. Modern solar panels do not pose a threat to soil as the silicon-based PV cells are well protected to avoid any risk of trace metal leaching.

Check out this [link](#) for more FAQ answers from the Department of Energy

Who can I talk to?

here is a non-extensive list of resources if you are interested in solar consultation!

[Harvest Solar](#)

[Michigan Gov](#)

[SEIA](#)



Appendix D: Background References

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