

# DRAFT In Review

## PERCEPTIONS OF MAPLE PRODUCERS TOWARDS CLIMATE CHANGE

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### Abstract

The Northern Forest (NF) region of Vermont and New York is home to an estimated 1,200 commercial maple producers who rely on maple production as a source of income, as the basis for longstanding family and community traditions, and as an essential component of the agritourism industry. Declines in maple production are projected in the future due to climate change and its potential impacts on weather patterns necessary for sap flow, forest type (i.e., from maple to oak-hickory-pine; Perkins, 2007), and tree health and vigor (Wilmot, 2012). Because maple producers depend on the health of sugar maples for their livelihood and cultural traditions, adapting to declines in maple production may be necessary in the future and will require planning. The goal of this study is to engage maple producers in the development of strategies that help them plan for and adapt to the potential impacts of climate change. As a first step toward identifying elements that could influence the ability of maple producers to adapt to climate change, in-depth telephone interviews were conducted in 2014 with a small sample of maple producers (n = 14). Interviews were recorded (with interviewee permission) and transcribed verbatim. Interview data were then analyzed for patterns (i.e., concepts and themes) in the comments of interviewees. Interview results indicate that the majority of interviewees (72%) think climate change is occurring, though variation exists in how they define climate change. Most interviewees also indicated that their businesses are currently adaptable to change in general, with larger production businesses (i.e., those having a greater number of taps) being more able to adopt new technologies, offer a diverse product line, and distribute their product out-of-state. Implications for maple production businesses are discussed.

Key words: maple production, perceptions, climate change

### 1.0 Introduction

Tapping sugar maple trees to produce syrup and other maple products has been a long-standing tradition for many people in the northern portions of North America. Maple producers enjoy economic benefits from their production of maple syrup and often times the production process itself becomes a family or community tradition that shapes the identities of its participants. As more information about climate change and its impacts on ecosystems becomes available, it is becoming evident that the maple production industry is threatened by the potential impacts that climate change will have on forest structures and health, as well as on the weather patterns necessary for quality sap collection.

In Vermont alone, approximately 1,320,000 gallons of maple syrup were produced in 2014; New York State, the second-largest producer in the United States, generated 546,000 gallons. Data from 2013 reveal a high production value overall for both states: over \$49.4 million in Vermont and over \$25.0 million in New York. With the average price per gallon in the United States hovering around \$37 in 2013, the importance of the maple syrup industry can easily be seen (USDA NASS, 2014). Further, maple production has become a part of the culture of the Northern Forest Region (i.e., the forested northern-most counties) in these two states, and continuing the traditions of maple production into future generations is of utmost importance. As Hinrichs (1998, p. 528) notes in his qualitative study on maple producers in Quebec and Vermont, “maple syrup production is regionally bound; its very practice connects production to region and place.” This strong connection between maple production, the land, and the people over generations has created a culture based in maple production for many communities and residents in the northern forest region.

Data on climate change and its potential impacts on forest types and health in North America suggest a decline in maple production in the Northern Forest (Perkins, 2007). Because of the importance that maple production holds for producers in the Northern Forest, it is important to help maple producers adapt to the potential impacts of climate change. If strategies to adapt to changes in forest type, tree health, and weather patterns cannot be developed, many maple producers may see both the quality and quantity of their products diminish (Perkins 2007), which could hurt both the economic and cultural aspects of their livelihood.

Exploring the perceptions of maple producers towards climate change is the first step in identifying mechanisms that maple producers can use to adapt to the potential impacts of climate change. With this in mind, the objectives of the interviews with maple producers are: (1) to better understand maple producers’ knowledge and perceptions of climate change; and (2) to examine the ability of maple production businesses to adapt to change in general. Specifically, diversity in product line, breadth of customer base, flexibility of business structure and staff, ability to adopt new production technologies, and the resiliency of the

sugar bush itself were explored through interviews with maple producers in the Northern Forest Region of Vermont and New York.

## **2.0 Literature Review**

While there is a plethora of literature on climate change and its potential impacts on maple syrup production, very little work has been done specifically focusing on maple producers and their adaptability to climate change (Skinner et al., 2010). Further, there has been work done with maple producers and assessing their thoughts on the future of the industry (Farrell, 2011), but this work has failed to include climate change as a factor that will influence future syrup production.

Perkins (2007) suggests that the rise in temperatures will alter existing forest structure types and that, particularly in the Northeast, forests will transition from being primarily sugar maple to more of a mix of oak, pine, and hickory trees. The implications of this change for maple producers are obvious: they may eventually have fewer trees to produce syrup. Further, Wilmot (2012) suggests that the “health and vigor” of forests in the Northeastern United States could be negatively impacted by the effects of rising temperatures.

A study by Skinner and others (2010, p. 700) examined the relationship between rising temperatures and maple syrup production, resulting in an interesting conclusion: as the temperatures in the Northeast continue to rise, there may be a decline in the number of traditional sap flow days; “however, “by moving the starting date of the 8-week tapping window earlier, it appears that the decrease in sapflow days can be mitigated.” Simply put, warmer temperatures may allow for sapflow earlier in the season and for a similar number of days as currently exists. However, a shorter and earlier season may foster a greater risk of lower production levels and poor quality sap due to the early budding of trees. Variations in precipitation, and the spread of insect pests and diseases triggered by climate change could also affect sap flow and quality (Skinner, 2010). Understanding the potential impacts of climate change on maple production is valuable for efforts to find the best practices for maple producers seeking to adapt to the potential impacts of climate change. This study uses interviews to examine the perceptions of maple producers about climate change and the current ability of their business to adapt to change in general. A second phase of the study (not presented in this manuscript) uses a mail survey to obtain detailed information about these perceptions from a census of commercial maple producers in the Northern Forest Region of Vermont and New York.

## **3.0 Methods**

Information from the New York State Maple Producers' Association (NYSMPA), the Vermont Maple Sugar Makers' Association (VMSMA), and from University of Vermont Extension was used to identify maple producers in the Northern Forest Region of NY and Vermont. E-mail requests for an interview were sent to roughly 200 maple producers. Lists of key contacts, provided by University of Vermont Extension and by the NYSMPA, were used for the initial interview requests; additional interview requests were made using random selection of interviewees from NYSMPA and VMSMA online maple producer lists.

Telephone interviews were conducted with 14 maple producers in the Northern Forest Region of New York and Vermont. Interviews were recorded (with interviewee permission) with an Olympus DS-5000 digital voice recorder and were transcribed using Dragon Dictate 4.0 software (Nuance Communications, 2014). The length of the interviews ranged from 16 to 45 minutes, and each interviewee completed the interview from start to finish without interruption. The interview guide included questions about maple producers' perceptions of climate change, business characteristics and structure, products and services, use of up-to-date technology, and resiliency of their sugar bush. Some questions in the interview guide were derived from an interview guide provided by Dr. Brenda Murphy of Wilfred Laurier University, Ontario, Canada. Interview questions concerning business adaptability were adapted from concepts presented in Bjornberg & Nicholson, 2007, Tuominen, et al., 2004, Peltier, Zhao, & Schibrowsky, 2012, and Walker & Brown, 2004. The interviews were structured so that the most contentious subjects (i.e., perceptions of climate change and how maple producers deal with change) were addressed only after rapport had been built between the interviewer and interviewee.

The interview transcriptions served as the basis for identifying themes and concepts relevant to maple producers' perceptions of climate change and the ability of their business to adapt to change. Interview data were first analyzed for reoccurring statements (concepts) related to adaptability and climate change by the second author; these concepts were then grouped into themes based on patterns in the data. The number of respondents indicating each theme and concept was identified by the second author. The first author then used the concepts to independently identify the number of interviewees indicating each concept. Intercoder agreement (Creswell, 2009) was calculated for each concept through the use of ReCal2 software (Freelon, 2015). Intercoder agreement indicates the percentage of interviews for which both coders (i.e., researchers) agree a concept was identified by an interviewee. This percentage was then averaged across the concepts related to each theme to identify the overall intercoder agreement for the themes. An intercoder agreement of 80% or greater is recommended for “good qualitative reliability” (Creswell, 2009, p. 191; Miles & Huberman, 1994).

## **4.0 Results**

### **4.1 Business characteristics**

Fourteen maple producers (eight from New York and six from Vermont) were interviewed. One maple producer purchases syrup for packaging and commercial sales, and does not currently tap any trees; the remaining 93% of interviewees tap their own sap, with 36% (5 interviewees) having 1,000 or fewer taps, 29% (4 interviewees) having between 1,001 and 3,000, 21% (3 interviewees) between 3,001 and 5000, and 7% (1 interviewee) over 5,000 taps. Five interviewees (36%) sell only maple syrup, three (21%) sell maple syrup and other maple products, and six (43%) sell both maple products and other farm-based products. Seven interviewees (50%) indicated that they hold on-site demonstrations during maple season, and six (43%) that they open their business to visitors during Maple Weekend (a maple producers' association-sponsored event during which maple production facilities are open to visitors); three interviewees (21%) indicated that they did not offer customers any type of tour, demonstration, or open house. Some maple producers (five interviewees; 36%) have a customer base comprised exclusively of local residents, while four interviewees (29%) serve primarily local clientele but some out-of-state residents as well; two interviewees have a statewide clientele base, while three distribute their products all over the United States. The majority of interviewees' businesses are family-owned and managed (12 interviewees, 86%); two are owned and managed by a single owner. Three have volunteer helpers and three hire paid staff to help during maple season.

#### **4.2 Theme 1: Perceptions of climate change**

The average intercoder agreement for concepts related to perceptions of climate change was 81%. The majority (72%) of interviewees thought climate change was occurring, but variation was found in their definitions of climate change. Half of the interviewees indicated that climate change involves extreme or odd weather patterns, 36% (five interviewees) indicated that it is the slow warming of the world, and 29% thought that it will cause warmer weather, less snow, and an early spring. Two respondents indicated that climate change has been accelerated by humans. Two respondents had no clear idea about climate change, and one considered it to be a political and marketing ploy. One interviewee indicated the concept of climate change as the "slow warming of the world" by stating:

"Climate change is the slow global warming of the world. There is a natural cycle of warming and cooling on earth, but I do think humans have accelerated that. I don't think it will happen in my lifetime, and probably not my kids' lifetime either, but it will happen and I don't think there's anything we can do to stop it."

There was less consensus in regard to whether or not maple producers believed that climate change had the potential to affect maple production in *their* state, with 50% of respondents expressing the belief that their state's maple production industry will be impacted. More than half of producers (57%) replied that, although they believe climate change will affect the health of sugar maple trees in the Northeast, the impacts "won't happen in my lifetime." A few also indicated that their sugar bush was far enough north that their business wouldn't be affected (14%):

"We may see some invasive species, and pests like the longhorn beetle, but I really don't think that it's going to be happening in my lifetime or anytime soon. I think we are far enough north that it's going to be a very long time before anything is."

Two interviewees also indicated that the north-facing aspect of their sugar bush might help protect it in the future:

"I do think that we will survive it where I am, and I do have a north facing bush, so I think it won't impact us as bad as it will others."

When asked for their perceptions of how climate change will affect maple forests, five (36%) indicated that maples will no longer be able to thrive due to the warmer climate. Three interviewees (21%) indicated that climate change will cause maple trees to "move north."

"I do think it's going to have an impact. I think that it's going to move the sugar maple populations north."

Six interviewees indicated that sap flow times will vary by year in the future. Four (29%) indicated that climate change will encourage the spread of insect pests. Two indicated that there will be no change in maple health.

Business owners were asked if they were currently making any changes in their business in response to climate change. Six interviewees (43%) indicated that they tap earlier in the season now; two (14%) keep a reserve of syrup on hand from the previous year just in case production is low, and one purposefully keeps his product line and services diverse. Multiple changes are being used by some interviewees as exemplified by two who both keep a reserve of syrup on hand and tap earlier. Five interviewees (36%) indicated that no management changes were needed and/or being made. One interviewee, who taps earlier in the season, stated:

"In my career, which is then about 30 years in this business, what I have seen, and actually what I've documented, is that we've seen the sugaring season starting anywhere from 1 to 2 weeks earlier than it has historically in the past. And for the most part, with a few exceptions, we've also seen the end of the sugaring season coming about a week earlier than we've

previously seen. So really, I think that changing temperatures in extreme fluctuations in weather has already started to affect the sugaring season.”

#### **4.3 Theme 2: Adaptability of business**

A series of questions designed to obtain information about how businesses would respond in a given situation were asked in order to collect information about business adaptability. The average intercoder agreement for concepts related to perceived business adaptability was 86%. First, interviewees were asked “If an employee suddenly quits during production season, how would you deal with this problem?” Seven interviewees (50%) indicated that they would work longer hours, six (43%) that they would find someone else to help, and two (14%) that they would get their family to help.

“[I would] work longer hours.”

“I guess I would have to scramble to find some help to pick up the slack.”

“We would just have other key employees fill in.”

Second, interviewees were asked “If your maple production is extremely low one year, how would you deal with this problem?” Seven interviewees (50%) indicated that they would buy sap from another producer, and five (36%) indicated that they would weather through the difficult situation. Several maple producers who had experienced times of low production in the past discussed the ways in which they had previously dealt with this situation. Two (14%) indicated that they had reduced or eliminated the wholesale portion of their business, and two kept a reserve of syrup on hand from the previous year; one producer also increased the price of his syrup:

“We actually only made about half of our normal crop, so we pretty much hunkered down. We didn't do the wholesale part of our business anywhere near the degree of what we have in the past. We try to have some carryover from one year to the next, and so that year we did have a good amount of carryover luckily. We had to have a price increase, which was part of the adjustment. We didn't make as much as we usually do, but we also didn't spend as much.”

The third question asked was “What prevents you from adopting new maple production technologies?” The majority (10 interviewees, 71%) indicated that the financial expense associated with new technologies was somewhat of a barrier for them; four (29%) actively keep up-to-date on new technologies anyway. Three indicated that they typically wait to see what research recommends, and then make the decision about whether to adopt the new technology. Four (29%) indicated that it is important that they quickly see a return on their investment in any new technology.

“There was a time when I said I would never have anything but buckets. I was never going to have a reverse osmosis machine. I was never going to do tubing. But after seeing so many people starting to use these new equipments, and talking to them about how cost-effective they were, I decided to change my mind and give them a try, and now I'm happy that I did. Basically, if the research says it's good for your business, then we go for it.”

With regard to the types of newer technology recently implemented or being considered, five interviewees (36%), four of whom owned larger businesses with 1000 or more taps, specifically mentioned installing leader check valve spout adapters (used in order to maintain good sap flow throughout the maple season; Perkins, 2009).

“Yes, we installed the leader check valve spouts a few years ago, and that helps considerably.”

Other types of technologies being considered by owners include reverse osmosis (mentioned as a future plan by one interviewee) and vacuum tubing systems (mentioned by four interviewees).

“I said earlier about the reverse osmosis, but we're also planning on updating our systems with vacuum tubing to keep up-to-date with that.”

Fourth, interviewees were asked “If a portion of your sugar bush was badly damaged by a storm, how would you deal with this problem?” Five (36%) indicated that they would buy sap or syrup from another maple producer, four (29%) would harvest timber where possible to generate income, three (21%) would replace sap lines and repair the damage if possible, and two (14%) would temporarily shut down all or a portion of their business. One mentioned talking to an expert about options, and two would look for emergency government assistance.

“I don't know. I guess it would cut the trees and really step back and see how I could tighten up things, and try to assess whether it be worth it for me to keep producing.”

“Because we do logging as well, we would harvest that timber as much as we could, and clear and clean it up, and put the lines back up as best as we could.”

## 5.0 Discussion

The majority of the maple producers interviewed expressed, in some form or another, that they believe climate change is a real phenomenon and that the impacts of climate change have the potential to affect the maple industry, but primarily for the next generation. The business modification currently being made by some producers (in response to the sap flowing earlier) is to start tapping trees earlier in the season.

Data compiled concerning business characteristics and the adaptability of maple production businesses in general shed some light on the adaptability of the businesses owned by the interviewees. The breadth of the geographic distribution of the customer base (i.e., local, within-state, and/or out-of-state) appears to be somewhat influenced by the size of the business. A higher percentage (55%) of the nine interviewees with over 1000 taps (these nine interviewees include the one interviewee who does not tap, due to his extremely high syrup sales) sell their maple products out-of-state, as compared to 40% of the five interviewees with 1000 or fewer taps. In contrast, 60% of interviewees with 1000 or fewer taps sell primarily to local residents, as compared to 22% of those with over 1000 taps.

Both the size of the business, and whether it is farm-based or not, appear to affect the ability of interviewees to offer diverse products. Farm-based maple production businesses in general were able to offer non-maple products such as produce and meats. A greater percentage (55%) of the nine interviewees with over 1000 taps (these nine interviewees include the one interviewee who does not tap, due to his extremely high syrup sales) offered both maple and other farm products; only one of the five interviewees with 1000 or fewer taps offered this diversity of products. Product diversity may be important to the overall financial well-being of these businesses in the future, especially during years of low maple production.

Most of the businesses were family-based; some had volunteer and/or paid helpers. The management structures of the businesses appear to be very flexible due to the family-base, in that the need for additional help could be quickly provided by family members. One maple producer indicated that he was easily able to hire additional volunteers from the community through his connections with the local high school.

The adoption of new technology appears to be strongly related to business size. For example, 50% of the eight interviewees having over 1000 taps indicated that they had installed leader check valve spout adapters, as compared to 20% of the five interviewees with 1000 or fewer taps. Only two interviewees indicated that nothing prevents them from adopting new technologies, both of whom had over 1000 taps. Businesses with a larger number of taps are likely to receive greater profits from maple production which can then be used to purchase new technology. Vacuum tubing systems and leader check valve spout adapters were most often mentioned by interviewees as new technologies that they had either recently installed or wished to install in the future.

Sugar bush resiliency appears to be the one business component that maple producers indicated they have little control over. Damage to a sugar bush by extreme weather events was identified by most interviewees as something that they deal with after the fact, and usually by “weathering through” the event and its impacts. With regard to climate change specifically, two producers mentioned that a portion of their maple bush was on a north-facing slope, and that the cooler temperatures on these slopes might help maintain the health of their maples in the future. More research is needed, though, to see if northern exposures could actually foster maple bush resiliency by ameliorating the potential impacts of climate change.

Some limitations should be considered when using the results of the interview portion of this study. First, only a small sample ( $n = 14$ ) of interviewees was included; this was intentional since the study design incorporated interviews as a mechanism for informing the dominant, survey phase of the study. Because of the small sample size, a combination of key contacts and randomly-selected maple producers was used to obtain diversity in the sample with regard to business characteristics. Second, the interviews were delimited to maple producers in the Northern Forest Region. Producers in more southern portions of NY and VT, who may experience greater impacts from climate change in the future, were not included. Thus, these results should not be generalized to maple producers in regions south of the Northern Forest Region.

## 6.0 Conclusion

Maple syrup production is a large industry and is a source of income for a vast number of people in the Northeastern United States. In addition to the economic significance that maple syrup production has, Hinrichs (1998) found that maple syrup production contributes to producers’ “overall livelihood, cultural identity, and lifestyle.” The maple syrup production industry has its own “cultural economy” that is embedded deeply in the lives of maple producers, and that provides individual, family, and community values. Improving the adaptability of maple production businesses in the future, should the potential impacts of climate change become real, may be imperative to the future generations of maple producers.

While our study indicates that maple production businesses in general have the flexibility needed to adapt to change, concerns exist primarily for the smaller operators. Specifically, expanding customer base and product diversity to include non-maple products may be necessary to maintain economic profitability should maple production decline in the future. In addition, identifying ways to increase the adoption of newer maple production technologies may be essential for all maple producers.

Sugar bush resiliency is of utmost concern since the maple production industry cannot operate without healthy trees. Strategies for increasing the resiliency of maple forests in particular are needed.

The results of these interviews have been used to write a mail survey. The mail survey, conducted in the fall of 2014, focuses on the relationships between the adaptability concepts identified through interviews (e.g., technology, customer base, product diversity, management, and sugar bush resiliency) and ability to adapt to climate change. Following the completion of the survey, input from maple producers will be obtained to identify mechanisms for increasing their ability to adapt to the potential impacts of climate change in the future.

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