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Entrepreneurial Behavior, Technology Adoption, And Climate Change Resilience: Evidence From Small And Medium-Scale Livestock And Maple Producers In Vermont

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ENTREPRENEURIAL BEHAVIOR, TECHNOLOGY ADOPTION, AND CLIMATE CHANGE RESILIENCE: EVIDENCE FROM SMALL AND MEDIUM-SCALE LIVESTOCK AND MAPLE PRODUCERS IN VERMONT

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Abstract

Agriculture, particularly livestock and maple production, is at the core of Vermont's identity, landscape, and economy. Although Vermont is famous for its unique small farms and exceptional maple syrup, more recently it has become known as one of the fastest-warming states in the United States, threatening the viability of the state's vibrant agricultural sector. In addition to climate change, increasing farm consolidation, low farmgate prices, market competition, and changing consumer demands and lifestyles have begun to affect the viability of small and medium-scale livestock farms and maple operations.

While numerous policies and programs seek to ensure the viability of these sectors, a frequently promoted strategy is for farmers to be entrepreneurial to adapt to changing environmental and market conditions. However, little is known about Vermont producers' perspectives and intentions towards entrepreneurial behavior, what factors are associated with these behaviors, and what challenges they face that restrict engaging in these behaviors. This study explores the entrepreneurial behaviors of livestock and maple producers, the two most prominent agricultural sectors in Vermont, employing the Theory of Planned Behavior (TPB).

Chapter 1 draws on qualitative data from 15 in-person interviews with Vermont livestock farmers and survey data from 28 respondents. I used a convergent parallel design mixed methods approach to integrate findings at the results stage. Farmers exhibit a myriad of entrepreneurial behaviors, that could be broadly classified into four main typologies as diversification entrepreneurs, eco-entrepreneurs, innovative entrepreneurs, and pluri-active entrepreneurs. Behaviors appear influenced by farmers' attitudes such as being innovative and opportunistic, being resiliency focused, low growth minded, and/or efficiency focused. While being influenced by other farmers, family, customers, employees, and their community, these farmers also display high perceived behavioral control or self-efficacy. However, in some instances, entrepreneurial behaviors are challenged by concerns related to personal wellbeing, market challenges, climate change, and labor and housing that inhibit farmers' adoption of approaches that might enhance the viability of their operations.

For Chapter 2, I used panel data from 46 Vermont maple producers participating in the 2020 and 2023 Vermont Maple Producers Surveys to conduct a path analysis of technology adoption behavior as framed by the TPB. Perceived behavioral control has a significant mediating effect between producers' climate change perceptions and their technology adoption behavior. Greater levels of concern over climate change had a significant negative association with perceived behavioral control, while perceived behavioral control had a significant positive association with technology adoption behavior. Favorable attitudes towards adopting technologies were significantly negatively associated with household income, and positively associated with concerns about market competition. Perceived behavioral control was positively associated with income from maple and with concerns around labor costs, and negatively associated with the scale of the maple operation. Further research may benefit in investigating other sustainable climate adaptation and mitigation strategies for maple producers that align with farmer motivations and resources.

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CHAPTER 1: INTRODUCTION

Background

Agriculture, particularly livestock and maple production, is at the core of Vermont's identity, landscape, and economy. Livestock and maple production are the two most prominent industries in Vermont, contributing extensively to Vermont's economy, through production as well as tourism, and is an integral part of Vermont's landscape and heritage. According to the 2020 Vermont State Agricultural Report, in 2019, 65% of the state's agricultural sales were dairy products, 8.5% cattle and calves, 2.0% hay, and 7.3% maple products (USDA, 2021). While Vermont's dairy and beef products contributed only 2.0% of total US dairy and beef sales, Vermont maple syrup constituted a majority (51%) of total US maple production in 2020 (USDA, 2021).

Both the livestock and maple sectors in Vermont are mainly constituted of small and medium-scale farms. With 868 dairy farms in Vermont in 2012, a majority remained family-owned, comprising 82% small farms, 15.1% medium-scale, and 2.8% large-scale farms (Vermont Dairy Promotion Council, n.d.). According to the Center for Rural Studies at the University of Vermont, most Vermont maple producers are small and independent makers with an average of 3,451 taps that produce 1,221 gallons of syrup (Atlantic Corporation, 2019). However, the relatively small number of large-scale operations with over 5,000 taps produce the majority of maple syrup in the state. Past research in Vermont has suggested small and medium-scale farms are a core component of food systems and provide over 20% of the regional value of agricultural commodities (Liang, 2011), yet often receive less public support (Neher et al., 2022).

Although Vermont is famous for its unique small farms and exceptional maple syrup, more recently it has become known as one of the fastest-warming states in the United States (Wasilenko, April 2023), threatening the viability and sustainability of the

state's vibrant agricultural sector. In addition to climate change, increasing farm consolidation, low farmgate prices, and market competitions have begun to affect the viability of small and medium-scale livestock farms and maple operations. Changes in consumer demands and lifestyles where people tend to consume less milk and farmers receiving low prices and facing high input costs have made farmers interested in scaling up their operations, losing their small-scale farming structures (Kardashian, May 2023). According to the Vermont State Auditor's Office, the number of dairy farms in Vermont decreased from 4,017 farms in 1969 to 636 farms in 2020, displaying an 84% reduction in small and medium-scale farms (Hoffer, 2021). Following the COVID-19 pandemic, the average price that dairy farmers in Vermont received through the federal milk market system plummeted 27%, exacerbating the trend of small dairy farms closing (Hall, May 2022). Along with small farms having to compete with the growing number of larger farms and economies of scale, they are also challenged by environmental concerns such as nutrient runoff and the reducing demand for milk consumption in the US (Kardashian, May 2023). Similarly, maple producers witness various challenges in maple production, one of which includes climate-related challenges in terms of sap flow timing, variability in sap season and boil season, and fluctuations in maple syrup yield that has potential to threaten the sustainability of this flourishing sector (Legault et al., 2019; Snyder et al., 2019).

Amidst many of these challenges, entrepreneurial behavior in the agricultural sector has often been presented as a strategy that would help small and medium-scale farms remain resilient to the challenges they face (Dickes et al., 2020). The Vermont Agency of Agriculture, Food and Markets (2020) states that it is crucial for Vermont farmers to be innovative and adapt to economic forces and market changes, while recognizing market niches, in a dynamic environment characterized by changing climate, water

quality concerns, land-use patterns, and changing consumer preferences and markets. Likewise, some maple producers perceive that adoption of technologies such as tubing systems, tap hole sanitation, vacuum delivery, and novel sap processing practices might enable them to adapt to and even help mitigate climate-related challenges to their maple syrup production (Legault et al., 2019; Ahmed et al., 2023).

Although enhancing entrepreneurialism in agriculture is commonly presented as a strategy to adapt to and mitigate environmental and market challenges, there is little evidence from a producers' perspective of farmers' attitudes, intentions, and perspectives towards entrepreneurial behaviors. Many studies emphasize the importance of capturing farmer perspectives in designing and implementing policy and increasingly consider the design of farmer-centric strategies and programs to address problems faced by farmers. Pannell et al. (2006) suggest that farmers' adoption behaviors will only be successful if they perceive that their goals will be met, and such adoption is based on subjective perceptions or expectations of farmers rather than the objective truth. Similarly, investigating climate change adaptation behaviors from a farmer perspective is important because risk perceptions are socially constructed and transmitted, and a wealth of past scholarships suggests that if farmers do not perceive climate change as a threat, they are less likely to engage in climate change adaptation or mitigation behaviors (Arbuckle et al., 2013). Specifically thinking about entrepreneurship in farming, Gasson (1973) suggest that economic theory explains economic behavior only in terms of availability of resources, but farmer actions are much more complicated and centered around farmers values and goals that need to be explored from a farmers' perspective. Therefore, this study aims to investigate how producers exhibit entrepreneurial behaviors and what factors are associated with it, in Vermont's livestock and maple sectors. In Study 1, we

investigate in what ways small and medium scale livestock farmers exhibit entrepreneurial behaviors, and what factors are associated with these behaviors. In Study 2, we limit our scope of entrepreneurial behavior to technology adoption behavior in the maple sector, by investigating small and medium scale maple producers' technology adoption behavior and what factors are associated with it, particularly concentrating on producers' perceptions towards climate change.

The remainder of this chapter dives in-depth into the literature on entrepreneurialism in agriculture, presenting how entrepreneurialism is displayed in the agricultural sector, including its determinants, operating contexts, challenges, perspectives, and criticisms. The Theory of Planned Behavior serves as the theoretical framework to guide this review of literature, and the chapter concludes with a conceptual model derived from this theory.

Literature Review

What is Entrepreneurship in Agriculture?

Entrepreneurship has multiple facets as identified by various theories and studies. Entrepreneurial behavior relates to innovation, proactivity, risk-taking, autonomy, and competitiveness (Daneluz et al., 2022). It involves the willingness to innovate to revitalize market offerings, to be more proactive than competitors to engage in new market opportunities, to experiment and take risks with new and uncertain products and markets, and to allocate resources into projects that are costly while having considerable chances of failure (Daneluz et al., 2022).

In past entrepreneurship literature, agriculture is less prominently studied and is often excluded from traditional entrepreneurship research themes (Dickes et al., 2020). According to Vik and McElwee (2011), evidenced by a literature review conducted by

McElwee (2006), research into entrepreneurship in farming has not been investigated much, despite farmers being a rich resource for study in the area of entrepreneurial capability and myths regarding their (in)ability to be entrepreneurial. Dickes et al. (2020) suggest that this lack of attention in entrepreneurship literature towards exploring entrepreneurship in farming might be because farmers as entrepreneurs seem to fall outside of the traditional entrepreneurship research themes. The term 'entrepreneur' is typically referred to those engaged in industrial activity and farmers are seldom regarded as industrial entrepreneurs. When thinking about agriculture in a business context where agricultural operations are aimed at marketing and profiting from the operation, the success or failure of an agricultural operation would depend on how creatively the operators respond to the challenge of emerging opportunities (Anand Singh & Krishna, 1994). Since the label of 'entrepreneur' describes a multitude of activities, conceptualizing and defining what constitutes entrepreneurialism in agriculture and what does not is a challenge.

Early work by Schumpeter (1934) views entrepreneurs as small business owners or managers who keep ahead of competitors through better management and the introduction of new, innovative products, and processes. More recent authors refer to entrepreneurs more broadly as individuals who manage a business with the intention of expanding that business and with the leadership and managerial capabilities for achieving their goals (Gray, 2002; McElwee, 2006). Such authors indicate while many small business owners often perceive themselves as entrepreneurs, running a small business and being entrepreneurial is not the same thing. While successfully operating a business requires managerial skills, being an entrepreneur requires innovative skills (McElwee, 2006). Although many associate fresh start-up businesses as entrepreneurial ventures, even existing small and medium scale enterprises can

display varying levels of entrepreneurialism in ways that sustain or constrain the firms' abilities to survive and prosper (Gray, 2002).

In discussing characterizations of entrepreneurial *farmers*, Carter (1998) and Eikeland and Lie (1999) identify farmers that engage in pluri-activity and diversification as entrepreneurial farmers. As appearing in the literature review by Fitz-Koch et al. (2018), Lauwere et al. (2002) distinguishes four groups of farmers as: (1) traditional growers who strive for development through scaling up and specialization; (2) prudent farmers characterized by financial conservatism and who are seen as solely farmers; (3) socially responsible farmers who balance financial success of the farm with perceived social and environmental responsibilities; and (4) new growers who exhibit social and growth orientation towards aligning with social norms, taking consumer demands into account, improving business efficiency, and producing and marketing goods in a socially justified way. Based on this typology, Fitz-Koch et al. (2018) conclude that only the socially responsible farmers and new growers are entrepreneurial, in that they exhibit self-criticism, leadership, creativity, perseverance, and proactivity (Fitz-Koch et al., 2018).

Other studies have sought to categorize farmers as entrepreneurial based on the skills of farmers, in terms of opportunity-recognition skills, relationship building, conceptual thinking and problem solving, organizing, strategic competences, and strategic planning (Lauwere et al., 2002; Man et al, 2002). Carter (1998) emphasizes that "portfolio farmers" (who engage in other businesses in addition to farming) more willingly identify themselves as entrepreneurs, are more market-oriented, and employ more complex managerial strategies as compared to other farmers who engage exclusively in primary production. However, portfolio farmers have also been described as displaying 'forced entrepreneurship', referring to a lack of inner

motivation towards entrepreneurship from the farmer's side, but rather a perceived need to adapt farm practices in the face of external pressure (Vesala and Peura, 2003).

In conceptualizing a farmer as an entrepreneur, although no clear single definition prevails, different scholars present a broad range of definitions. Individuals who bear uncertainties and take risks (Cantillon, 1755), coordinate (Say, 1803), innovate (Schumpeter, 1934) and arbitrage (Kirzner, 1979) are considered entrepreneurs. Compared to other business contexts, studying farmers as entrepreneurs is complex as farmers could be owners, tenants, managers, subcontractors, or a combination of these roles, which indicates that methods used to analyze business entrepreneurs in other sectors may not be directly transferrable to the investigation of farmers as entrepreneurs (McElwee, 2008).

In a taxonomy of entrepreneurial farmers, McElwee (2008) distinguishes between 'farmers as farmers' and 'farmers as entrepreneurs.' In classifying the economic activity of farmers, the author distinguishes two broad categories: considering farmers as entrepreneurial active individuals and considering farmers as managers of a business. In McElwee's (2008) typology, a farmer as a farmer engages in limited diversification and pluri-activity that is dependent on falling prices or demand, and other push factors such as topography and physical location, access to transport and distribution networks, and proximity to markets. This farmer usually possesses technical skills and utilizes support networks such as farmers unions and professional bodies. The farmer's strategic orientation is based on cost price reduction, achieving more efficiency but often less profitability, and with relatively little awareness of the range of potential market opportunities. This type of farmer may also collaborate with other farmers but largely on an ad hoc basis, displaying an individualistic orientation.

In contrast to the farmer as a farmer, the farmer as an entrepreneur possesses the skill to engage in entrepreneurial activity or can develop such skills. These farmers are compelled to engage in entrepreneurial activity by access to travel and distribution infrastructure, local potential for agri-tourism location, and other opportunities. Hence these farmers identify and benefit from a range of potential market opportunities which may include tourism, hospitality, and culture and entertainment-related farm activities, as well as high value agriculture and food production. Such farmers use the farm's resources and features in flexible and innovative ways and are motivated by the need for freedom and security. Farmers as entrepreneurs may thus play a greater role in the rural economy by providing employment opportunities and cooperating with formal alliances and networks (McElwee, 2008).

Another important distinction arising from the literature on entrepreneurial farmers and non-entrepreneurial farmers is with regards to innovation behavior (Dias et al., 2019). In competetive markets comprised of a large number of farms, with many competitors for traditional products, entrepreneurial opportunities can be derived through the development of new products and through innovations in the business process, distribution, and marketing (Pindado & Sánchez, 2017). Adapting to new changes, identifying opportunities for niche markets, strategically and creatively using and integrating innovations that improve resource use efficiency towards sustainable farming (especially in the context of limited financial and local resources), can all be characterized as entrepreneurial behaviors. And introducing product and marketing innovations to niche markets, adopting novel product certification schemes, engaging in direct sales networks and the elimination of intermediaries can all be seen as distinctive behaviors and activities of entrepreneurial farmers, compared to non-entrepreneurial farmers (Dias et al., 2019).

According to a study conducted by Vik and McElwee (2011) on Norwegian farmers, the authors emphasize that the recognition of business opportunities through cooperation and networking, innovation, and risk-taking, and strategic planning are major requirements for farmers, and through this they are able to find ways and strategies to create profitable businesses. For farmers to be entrepreneurial, they need managerial skills that can be taught as well as an entrepreneurial spirit that cannot be taught but can be supported to run a successful farm business (Kahan, 2012). A study that investigated entrepreneurial training for farmers also concluded that entrepreneurial training requires much more than managerial skills and should also incorporate training about entrepreneurial attitudes (Pyysiäinen et al., 2006). An extensive literature review conducted by Mudiwa (2018) found that, risk orientation, achievement motivation, innovativeness, decision-making ability, information-seeking behavior, coordinating ability, self-confidence, cosmopoliteness, and planning ability, in the order of importance, are components possessed by farmers who exhibit entrepreneurial behavior.

Entrepreneurship in the context of agriculture ultimately recognizes farmers as entrepreneurs who are passionate about their farm business, willing to take calculated risks, technically competent, innovative, and those who plan ahead to steer their business through stages of enterprise development, from establishment and survival to growth and maturity (Kahan, 2012). However to date the limited research on entrepreneurial behavior in agriculture is concentrated mainly on dairy, floriculture, and vegetable farmers in Asia and Africa (Mudiwa, 2018). Mudiwa (2018) argues that future research of entrepreneurial behavior of smallholder farmers outside of Asia, is needed to investigate how they can open-up market opportunities and spur economic development, especially in agro-based economies. Specifically in the United States,

studying entrepreneurship in farming is ‘one piece of the larger rural development puzzle to help struggling rural communities (Dickes et al., 2020).

Entrepreneurial Behavior in Agriculture: Determinants, Perspectives, and Challenges

Bird and Schjoedt (2017) argue that the recognition of entrepreneurial behavior – and factors associated with it – is valuable to entrepreneurs as it allows them to shape and change their behaviors for better outcomes, and also for stakeholders such as investors, local governments, and employees, as entrepreneurial outcomes also help meet their respective goals in financing and facilitating entrepreneurship, developing local economies, and increasing job opportunities.

While many argue that personal traits and human motivations are determinants of entrepreneurship, others present that environmental conditions also play a factor in entrepreneurship (Dickes et al., 2020). However, every farmer might not jump on the entrepreneurial bandwagon or would consider developing entrepreneurial skills as desirable or socially acceptable, due to individual backgrounds, cultural traditions, or social and institutional settings that could influence the individual’s willingness to learn or use entrepreneurial skills (Pyysiäinen et al., 2006). Kahan (2021) similarly argues that even though many small-scale farmers possess qualities to be entrepreneurial, they still focus on maintaining their traditional way of life, where their production decisions are guided by their needs, and not by what is possible.

Entrepreneurs are often seen as those involved in optimizing profit, to run an efficient, productive, and money-making business (Davis-Brown and Salamon, 1987). This differentiates entrepreneurial farmers from yeoman farmers who generally implement risk-averse financial strategies that assume family cooperation and enterprise needs over individual needs, whereas entrepreneurial farmers emphasize on the individuality

over the relational aspects of farming (Davis-Brown and Salamon, 1987). Other studies highlight how entrepreneurship is often viewed as an intrinsic aspect of farming in North American farm communities, where the community is bound by the virtues of an entrepreneurial spirit, offering a cultural identity based on family continuity and the ability to manage risks of farming (Dudley, 2003). However, still others emphasize contrasts between rural agrarian community values and entrepreneurship, with Niska et al. (2012) noting that peasantry and entrepreneurship are generally regarded as contradictory farming strategies and farm categories (Niska et al., 2012).

Discussions on the multi-functionalism of agriculture goes beyond food production to incorporate landscape, natural values, rural employment, and rural vitality. Multi-functionalism emphasizes on-farm diversification as a farm strategy and farms are encouraged to broaden the production and processing to incorporate provision of tourism, leisure, and care services (Niska et al., 2012). In contrast, Pemadasa (1994) discusses how entrepreneurs' objective is typically to extract as much profit as possible from an investment, and due to the profit maximizing and commercial viability goals of entrepreneurs, it will result in long-term ethical erosion, cultural degradation, and inevitable environmental destruction. The author also starkly argues that it is not possible to expect ecological compassion, humaneness, or environmental consciousness from an entrepreneur.

Holt-Giménez (2017) offer a more mixed perspective emphasizing how some small farmers exist outside the strict rules of profit mazimization in a capitalistic economy and make a decent living by combining different forms of production and exchange such as agroecological, organic, non-organic, market-oriented, and self-provisioning into farming styles that lower costs and reduce exposure to market risk. Cox (2023)

writes about how the Green Revolution driven by public interests and food security concerns in the 1960s, also rejected small farmers and indigenous knowledge in favor of corporations and top-down solutions that encouraged large-scale industrial approaches and dependencies. He also discusses the role of technologies in this endeavor in aggravating the problems of the Green Revolution. However, he also recognizes the role of transformative technologies that can reverse the existing unsustainable methods of production to promote regenerative methods of production. He argues how even small farmers can be inventors, system thinkers, and technicians of the highest degree that use thoughtful and environmentally conscious technologies in agrarian communities. In the context of the pressing arguments about how entrepreneurial behavior leads to the erosion of culture, environmental degradation, and biological diversity, Cox (2023) argues that farmers can harness technical innovation and creativity to regenerate natural processes and produce healthy food while restoring landscapes.

When discussing entrepreneurialism and how entrepreneurialism in agriculture must be assessed, studies indicate the role of culture in influencing strategic choices around entrepreneurial behavior in agriculture. In a study conducted with Scandinavian farmers, the authors found that a cultural intolerance towards being different and overachieving (called ‘Jante-ness’) among the farmers had a negative effect on their entrepreneurial orientation and hence explained low rates of innovation and entrepreneurialism in Scandinavian agriculture (Hunter et al., 2023). In other words, in studying entrepreneurial behavior in agriculture, it is important to understand the context in which farmers operate. This is useful in assessing the degree to which their entrepreneurial behaviors are shaped by specific challenges or opportunities that allow them to be entrepreneurial to survive and thrive in a competitive environment.

Wale and Chipfupa (2021) integrate literature and survey data from South Africa to investigate entrepreneurship in agriculture in the context of smallholder farmers. The authors highlight different theories in which entrepreneurialism operates among smallholder farmers: economic theory, resource-based theory, opportunity-based theory, subsistence theory, psychological theory, and social theory. Economic theory refers to economic incentives as drivers of entrepreneurial activities, and entrepreneurs are considered as rational economic actors who re-allocate resources in response to economic incentives and add value to maximize profits. However, considering smallholder farmers, the authors present that the goal of smallholder farmers is diversifying and adaptive decision making, which is not aimed at optimality (Wale and Chipfupa, 2021). Resource-based theory looks at the presence or absence of tangible or intangible assets and the enabling or deterring environment that promotes or inhibits entrepreneurialism. The varying access of smallholder farmers to land, capital, training, membership in cooperatives, and other resources influence their entrepreneurial behavior. Entrepreneurs that operate in opportunity-based theoretical context, identifies, and creates opportunities, and exploits those opportunities to derive value. Subsistence entrepreneurs have meager resources, service the informal economy, add value in subsistence marketplaces and engage in entrepreneurial activities to make ends meet. While psychological theories explain the behavioral factors that drive or motivate people to be entrepreneurial, social theories attempt to explain entrepreneurship from an entrepreneurs' cultural background and social context. Wale and Chipfupa (2021) conclude that smallholder farmers in their sample do not conform to growth-oriented entrepreneurialism and are mostly associated with subsistence entrepreneurialism and can be supported through government policies and local indigenous knowledge that can nurture their self-reliance.

From a psychological theoretical perspective, farmers displaying entrepreneurial behaviors also differ based on their values. Farmers' values are classified as instrumental, social, expressive, and intrinsic (Niska et al., 2012). Instrumental values imply that farming is performed as a means of obtaining an income, social values imply that farming is performed for the sake of interpersonal relationships, expressive values imply that farming is a means of self-expression, whereas intrinsic values imply that farming is treasured because it enables independence and a specific way of life (Gasson, 1973). Niska et al. (2012) investigates the values of farmers that display entrepreneurial behavior in comparison with those of peasant farmers. While peasant farmers possess social, expressive, and intrinsic values, entrepreneurial farmers are mainly guided by instrumental values, but also possess expressive values by being autonomous and independent (Niska et al., 2012).

However, monetary values and autonomy and independence are not the only values possessed by entrepreneurial farmers. Ecological entrepreneurship recognizes farmers that contribute to sustainable rural development through environmentally conscious agriculture. Such farmers pursue economic benefits through sustainable methods such as direct marketing that reduce the need for intermediaries and minimize waste, promote the local economy, and provide consumers high quality and healthy food (Niska et al., 2012). Such farmers, although engaged in profit maximization, also possess social and intrinsic values that serve the rural vitality and environmental wellbeing (Niska et al., 2012). Other studies that investigated 'yeoman' and 'entrepreneur' farmers highlight how these attributes were present among a sample of Scottish livestock farmers, but with no evidence for the existence of two distinct types as 'yeoman' or 'entrepreneur' (Austin et al., 1996). The findings of this study suggest that characteristics that exist among yeoman and entrepreneur farmers are not

mutually exclusive and typologies that basket farmers into the two categories must be approached with caution (Austin et al., 1996). This suggests that farmers that display entrepreneurial behavior with economic values towards profit maximization could also possess values towards social and ecological orientation.

Identities of farmers are critical elements to personal behavior as individuals are strongly motivated to act in a manner consistent with their identities (De Bernardi & Pedrini, 2020). Burke & Reitzes (1981) emphasize that once identities of individuals are integrated into the self and become central, individuals incorporate expectations and meanings related to the perceptions of the self as occupying a role and act aligned with these identities. In assessing entrepreneurial behaviors, it is also important to understand the identities of farmers as their identities could influence what kinds of entrepreneurial behaviors they exhibit, whether extractive and exploitative, or sustainable and socially and environmentally harmonious. De Bernardi & Pedrini (2020) describes the identity theory proposed by Gruber and MacMillan (2017) that considers individuals' emotions and meanings and explain why different entrepreneurs behave in different ways depending on which entrepreneurial behavior they deem appropriate.

Identity that has been considered in relation to environmental behavior has been categorized into two emerging categories as environmental self-identity and environmental identity. Environmental self-identity refers to the extent to which an individual sees him or herself as a person acting in an environmentally friendly way and action-oriented, whereas environmental identity refers to an individual who has a sense of connection to some part of the non-human world and a sense of belonging to nature (De Bernardi & Pedrini, 2020). These authors present that environmental self-identity and environmental identity triggered by environmental passion results in

specific entrepreneurial behaviors that the authors phrase as, eco-sober, eco-tipsy, and eco-drunk. Eco-sober entrepreneurs are characterized by a sense of heritage, memories, and generational knowledge, sustainability, and making a living. Eco-tipsy entrepreneurs are characterized by a search for a healthy lifestyle and environmental awareness, while eco-drunk entrepreneurs are characterized as those who deeply follow natural laws and have deep environmental faith, considering themselves as part of nature (De Bernardi & Pedrini, 2020).

Various studies also identify the identities of certain farmers as strongly production oriented. Such farmers who operate within productivist norms are focused on production maximization and scale enlargement (Seuneke et al., 2013). Although these farmers seek to develop new identities as multifunctional farmers, such multifunctional expressions and identities are not self-evident or encouraged within their production-oriented societies (Seuneke et al., 2013). This study also indicates that for the farmers in the sample, it has been a slow process to develop their entrepreneurial identities towards multifunctionality, by breaking free from the productivist norms and to realize that ‘good entrepreneurship’ goes well beyond productivist thought and action (Seuneke et al., 2013).

Fitz-Koch et al. (2018) emphasizes that a farmer’s identity is associated with environmental stewardship that looks after and takes care of the land, and kinship. Some farmers tend to maintain singular identities as farmers or entrepreneurs and some exhibit both identities to varying degrees. However, this study highlights that although farmers engage in entrepreneurial activities as agricultural portfolio entrepreneurs or tourism entrepreneurs, their identity as a farmer remains strong (Fitz-Koch et al., 2018).

A common assumption of entrepreneurialism in agriculture is that it is concentrated on economics and therefore, has limited association with technical and social relations. According to van der Ploeg (1990), entrepreneurial farmers' decisions around labor are guided towards reaching technical efficiency. Farmers oriented towards entrepreneurial behaviors such as diversification, while driven by economic motives are also driven by other factors related to wider farming family and social context. They would be motivated by the need to provide gainful employment for other family members or by the desire to contribute to wider social and environmental objectives such as providing employment opportunities for others in their specific rural community (Morris et al., 2017). López-i-Gelats et al. (2011) criticizes the concept of farm diversification that is centered on reorganization of land and finances, while neglecting labor. By studying a farming community in the Pyrenees that is characterized by labor scarcity, labor-intensive practices, and low mechanization, the authors explore various orientations of diversification within the community in displaying entrepreneurship. While certain farmers display absence of diversification, some display agricultural diversification in agricultural products, farmland diversification in terms of various on-farm practices such as organic farming and farm tourism, as well as farm labor diversification in terms of shifting family labor towards off-farm employment (López-i-Gelats et al., 2011).

Entrepreneurial behaviors in dairy and livestock farms that are exhibited in terms of adopting various technologies are related to the labor involvement around technology and labor savings. A study about a European automatic milking innovation system discusses how the potential benefits related to production increases and labor savings were overstated in instances, leading to unfulfilled expectations and a poor fit with farmer skills (Eastwood et al., 2017). Not only the skills of farmers, but the workers

employed by farms that use improved technologies would need skilled operators for such technologies to minimize occupational risks and hazards that can occur through improper awareness or skills around handling such technologies. Therefore, farmers' decisions around labor and who to employ, including specific training and skills of employees would need to be related to the kinds of entrepreneurial activities they implement on the farm.

Especially considering dairy and other livestock operations that are unique in terms of high risks of labor injury and illness and working conditions that constantly expose workers to animal-related risks and diseases, farms have begun to pay more attention towards strategic and sustainable systems of farming (Salimi, 2023). Decisions around creating a safe working environment for the livestock sector workforce has driven entrepreneurial farmers towards sustainable and safe entrepreneurial operations (Salimi, 2023).

Liang & Dunn (2014) explore how certain farms in New England orient towards multifunctional agriculture as an entrepreneurial activity. The study reveals how micro and small family farms have positive experiences with multifunctional agriculture when compared to large farms. While large farms were more interested in value-added operations, micro and small family farms were more likely to engage in agritourism and direct sales. Micro and small family farms also indicated positive experiences with multifunctional agriculture in connecting with customers and communities (Liang & Dunn, 2014), highlighting how the composition of farms with small size and family labor is related to the display of entrepreneurial behaviors.

Doss & Morris (2000) relate how women farmers tend to adopt improved technologies at a lower rate than male farmers. The authors highlight how gender is

linked to other factors that influence adoption behaviors, thereby influencing entrepreneurial activity. The disproportionate access to land and extension contacts of male farmers when compared to women farmers are factors that could result in unequal technology adoption rates (Doss & Morris, 2000). However, Mutenje et al. (2016) highlight that married women can indirectly influence their male counterpart's decision making and influence their agricultural innovation choices. Farmers also engage in on-farm agricultural innovation through leveraging various social capital by bridging, bonding, and linking (Cofré-Bravo et al., 2019). Social capital refers to changes in relations among individuals that facilitate action, and according to Putnam (2000), it is the stocks of social trust, networks, and values that people draw upon to improve their livelihoods and to pursue shared objectives. In the context of agricultural innovation in a case of Chilean fruit farmers, the farmers were seen to use all types of social capital – bonding, bridging, and linking in their support networks, based on personal motivations, innovation objectives, and resource endowments (Cofré-Bravo et al., 2019). According to this study, the farmers used open networks based on linking and bridging social capital to explore and access new knowledge and resources, and used closed networks based on bonding social capital to successfully implement and exploit new technologies and practices (Cofré-Bravo et al., 2019).

Kahan (2012) argues that in an ever-changing and increasingly complex global economy, entrepreneurship is a key factor for the survival of small-scale farming. With the consolidation of agriculture in recent decades, and the emergence and growth of large conventional farms, small and medium scale farms have struggled to compete as they face low commodity prices, high input prices, and low profit potentials, requiring small and medium scale farms to be more entrepreneurial to survive (Dickes et al., 2020). Jones and Pratap (2017) highlight that compared to

larger firms, smaller businesses are more proficient at innovation and job creation but are hindered by financial constraints and therefore are worth subsidizing.

Theoretical Framework: Theory of Planned Behavior

The Theory of Planned Behavior (TPB) by Ajzen (1991) explains that any volitional behavior arises from intentions to perform that behavior, and that can be predicted by three antecedents; attitudes towards behavior, perceived behavioral control, and subjective norms. Attitudes towards behavior is the degree to which a person has a favorable or unfavorable evaluation of the behavior, subjective norms refer to the perceived social pressure to perform or not perform the behavior, whereas, perceived behavioral control refers to the perceived ease or difficulty in performing the behavior (Ajzen, 1991). Bosnjak et al. (2020) emphasize how TPB continues to offer a useful framework for social and behavioral science research, while at the same time recognizing the theory as a work in progress as researchers continue to explore the interrelationships, feedback, and intricacies of the model by identifying mediating and moderating effects of various constructs and additional factors that could account for the complexity of human behavior.

The TPB has typically regarded attitudes, subjective norms, and perceived behavioral control as independent predictors of intention to perform the behavior. However, Barbera & Ajzen (2020) conducted three studies to investigate different individual behaviors in voting, reducing household waste, and energy consumption, and found that perceived behavioral control has a moderating role on attitudes and subjective norms in performing those behaviors. The authors further stated that greater perceived behavioral control strengthens the relative importance of attitudes in the prediction of intention, while greater perceived behavioral control tends to weaken the relative importance of subjective norms in predicting intentions (Barbera & Ajzen, 2020).

In the TPB, the link between intentions and behavior reflects how people tend to engage in behaviors that they intend to perform. However, Ajzen (1991) and Conner & Armitage (1998) emphasize that there is a complex interaction between perceived behavioral control and behavior as well, by which individuals are more likely to engage in behaviors over which they have control, and individuals are prevented from carrying out behaviors over which they have no control over. The authors suggest that even if intentions were held constant, behavior will be more likely to be performed with the increase of perceived behavioral control. Additionally, Ajzen (1985) also highlights that perceived behavioral control and intentions interact in their predictions of behavior such that intentions become strong predictors of behavior as the perceived behavioral control increases.

Ajzen (2020) also highlights various feedback effects that can occur between the constructs in the TPB. The author suggests that performance of a behavior could result in informing facilitating or impeding factors encountered by the actor in performing the behavior. This feedback could change the behavioral, normative, and control beliefs and influence future intentions regarding the behavior. The changes in behavioral, normative, and control beliefs could result in less favorable attitudes, subjective norms, and perceived behavioral control, all of which could lead to the inhibition of the intention to perform that behavior.

In addition to perceived behavioral control, an additional construct, actual behavioral control also moderates the effect of intention on behavior (Ajzen, 2020). Prerequisites for assessing actual behavioral control is an understanding of an individual's internal factors such as knowledge, skills, intelligence, etc. and external factors such as legal barriers, money, equipment, cooperation by others, etc. that are needed to perform the behavior or that can interfere with the performance of the behavior. However, Ajzen

(2020) notes since measurement of actual behavioral control is much more difficult than perceived behavioral control, most studies rely on perceived behavioral control as a proxy for actual behavioral control.

The TPB recognizes personality traits, intelligence, demographic characteristics, life values, and other such variables as background factors that could affect TPB constructs (Ajzen, 2020). The components of the TPB are assumed to mediate the effects of background factors on intentions and behavior. The theory recognizes the importance of background factors in providing valuable information about precursors of control, behavioral, and normative beliefs that predict attitudes, behavioral control, and perceived social norms. However, in the TPB model it is possible to examine the role of background factors in influencing or not influencing behavior by tracing their effects via proximal antecedents of behavior such as attitudes, social norms, and perceived behavioral control (Ajzen, 2020). Furthermore, although attitudes, subjective norms, and perceived behavioral control are independent predictors of intention conceptually, empirically they may correlate with each other with low to moderate correlations among them (Ajzen, 2020). The author highlights how any item of information can affect more than one of the theory's predictors and hence produce correlations among them.

The conceptual model of the TPB (Figure 1), including the constructs and their mediating and moderating roles, interrelationships, and feedback effects have been tested empirically through various studies. In a study that assessed the ecological conservation behavior of farmers in payment for ecosystem services programs through TPB, the researchers hypothesized correlations between TPB constructs with each other and the direct correlation of perceived behavioral control on behavior (Deng et al., 2016). Although the authors did not find evidence to support the

correlation between perceived behavioral control and behavior, they found significant correlations between attitudes with subjective norms and attitudes with perceived behavioral control (Deng et al., 2016). Similarly, in a study investigating the intention of farmers to engage in on-farm food safety practices, Rezaei et al. (2018) hypothesizes the correlations between attitudes, social norms, and perceived behavioral control. Chen (2022) studies farmers' decisions in cropland abandonment behavior and investigates links between TPB constructs and the effect of perceived behavioral control on exhibited behavior.

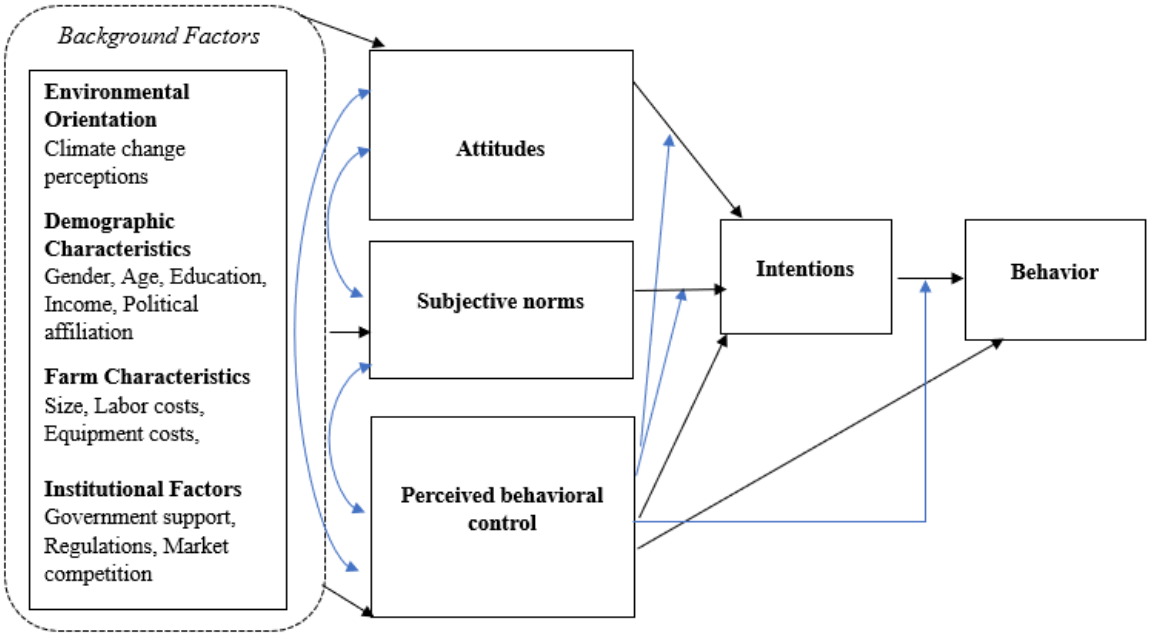


Fig. 1. Conceptual Framework Adapted from the Theory of Planned Behavior (Ajzen, 1991)

This thesis extends the TPB to explore farmers' behavior towards entrepreneurship, a subject that is not often studied among Vermont livestock and maple producers from a producer perspective. This study shows what psychological attributes and external factors influence farmers to engage in entrepreneurial activities, thereby contributing to entrepreneurship literature in the context of agriculture. It is important to understand the perceived importance of entrepreneurialism to farmers since farmers'

adoption behaviors will only be successful if they perceive that their goals will be met, and such adoption is based on subjective perceptions or expectations of farmers rather than the objective truth (Panell et al., 2006). Although policies are mostly based on economic theory that explains economic behavior only in terms of availability of resources, farmer actions are much more complicated and centered around farmers values and goals that need to be explored from a farmers' perspective in designing and implementing policies (Gasson, 1973). Therefore, this thesis investigates in what ways small and medium-scale farmers exhibit entrepreneurial behaviors and what factors are associated with their entrepreneurial behaviors, to inform policies that facilitate their resilience and sustainability in the long-term.

CHAPTER 2: ENTREPRENEURIAL BEHAVIOR OF SMALL AND MEDIUM-SCALE LIVESTOCK FARMERS IN VERMONT

Introduction

Agriculture, particularly livestock farming, is a core component of the economic and socio-cultural landscape, and identity of Vermont. In the Northeastern US, around 45% of agricultural land is used for pasture and forage production (Tichenor et al., 2017). While beef farming is an emerging sector with promising returns to farmers, dairy farming accounts for over 70% of agricultural sales, utilizes 80% of Vermont's open lands, and contributes a major share to the total milk produced in the New England region (Vermont Agency of Agriculture, Food and Markets, n.d.). With 868 dairy farms, of which a majority are family-owned, there are 82% of small farms, 15.1% of medium-scale, and 2.8% large-scale dairy farms in Vermont (Vermont Dairy Promotion Council, n.d.).

Although the dairy sector constitutes most of the agricultural production in Vermont, its viability and sustainability are currently threatened by the decrease of the number of dairy farms in the state. According to the Vermont State Auditor's Office, the number of dairy farms in Vermont decreased from 4,017 farms in 1969 to 636 farms in 2020, displaying an 84% reduction in small and medium-scale farms (Hoffer, 2021). Following the COVID-19 pandemic, the average price that dairy farmers in Vermont received through the federal milk market system plummeted 27%, causing the collapse of a number of small dairy farms (Hall, May 2022). Along with small farms having to compete with the growing number of larger farms with over 1,000 cows and economies of scale, they are also challenged by environmental concerns such as nutrient runoff and the reducing demand for milk consumption in the US (Kardashian, May 2023).

Amidst the constantly growing competition from large-scale producers, volatile prices that farmers receive, changing consumer behaviors, and pressing environmental challenges that Vermont small and medium-scale livestock farmers face, supporting their entrepreneurial behavior is often presented as a strategy that could support their survival in a dynamic and competitive environment (Dickes et al., 2020). However, little is known whether producers consider entrepreneurialism in farming as a strategy that could help them remain resilient, how entrepreneurialism is exhibited among farmers in Vermont, and what factors are associated with their entrepreneurial behaviors.

It is important to understand the perceived importance of entrepreneurialism to farmers since farmers' adoption behaviors will only be successful if they perceive that their goals will be met, and such adoption is based on subjective perceptions or expectations of farmers rather than the objective truth (Panell et al., 2006). Although policies are mostly based on economic theory that explains economic behavior only in terms of availability of resources, farmer actions are much more complicated and centered around farmers values and goals that need to be explored from a farmers' perspective in designing and implementing policies (Gasson, 1973). Therefore, this study investigates in what ways small and medium-scale farmers exhibit entrepreneurial behaviors and what factors are associated with their entrepreneurial behaviors, to inform policies that facilitate their resilience and sustainability in the long-term.

Literature Review

Entrepreneurial Behavior in the Livestock Sector

Entrepreneurial behavior of livestock farmers can be displayed in numerous ways, including using improved management practices, adopting new technologies, being innovative, and using novel production systems, while bearing considerable risks (Khanal et al., 2010; Hoffer, 2021; Daneluz et al., 2022). In the US, the investment in agritourism to diversify farm incomes and meet the potential market demand is a unique entrepreneurial activity of farmers (Dickes et al., 2020). Being innovative and entrepreneurial in farming also means new ventures and new ideas, new markets, new methods of production, management, and marketing (Pyysiäinen, 2006). Entrepreneurial behavior is exhibited in the rapidly changing and expanding dairy and beef sector in the US through increased productivity, owing to improved management practices, animal selection, technology adoption, and technological and managerial innovations (Khanal et al., 2010). The entrepreneurial behavior of dairy farmers is comprised of innovativeness, achievement motivation, decision making ability, risk orientation, coordinating ability, planning ability, information seeking, cosmopoliteness and self-confidence (Patel et al., 2014). The long-term success of agricultural production, future responsiveness, and flexibility of production systems are enhanced by aggressive marketing strategies, willingness of farmers to try new and untested crops and products, and education and access to information and experts (Sassenrath et al., 2010).

In the US, farmers exhibit innovative behavior in breed selection and repossess the decision-making power to their hands otherwise controlled by feedlots and packers (Gwin, 2009). In countries such as Brazil, adopting innovative practices and risk-taking in dairy farms is concerned with the use of medicines, machinery and

equipment, farm investments, and the use of new products to preserve milk quality (Daneluz et al., 2022). In the US beef sector, farmers display innovation and entrepreneurialism through product differentiation, where premium prices are earned through distinguishing characteristics of the product offering providing small beef producers an opportunity to create sustainable competitive advantage (Micheels et al., 2008). With the decline in beef demand for poultry and pork, beef producers have established innovative strategies to market their product offerings to meet consumer demand, such as through providing all-natural, organic, or grass-fed beef (Micheels et al., 2008). The US goat sector presents promising, where goat producers may have the opportunity to engage in value-added production to produce gourmet goat cheeses, goat milk based infant formula, and cater to a goat meat market (Hart et al., 2019). These producers may also adopt technologies used for cattle such as mobile applications, yield monitors, and auto-guidance systems, along with interconnected sensors collecting health and production data (Hart et al., 2019). Sheep producers in a Welsh farming community displayed entrepreneurial and innovative behaviors by exhibiting on- and off-farm diversification to agriculture-related and non-agricultural businesses, adopted technologies from grass management to breeding and sheep health and nutrition, and engaged in resource maximization strategies such as renewable energy use and adopting differentiation strategies for new market avenues (Morris et al., 2017).

Individual farming entrepreneurs are interested in developing new networks by devoting their time and resources to maintain collaborations, specifically with other producers, consumers, public agencies, and non-governmental organizations (NGOs) (Gwin, 2009). Crowley et al. (2019) also emphasizes the importance of developing collaborations between various stakeholders to encourage innovation. In the US,

adoption of technologies differs across regions, socio-economic groups and time, and most adopters are young, have college degrees, and greater debt compared to assets (Khanal et al., 2010; Pruitt et al., 2012).

Although entrepreneurship in the US agricultural sector is displayed in various ways, not all entrepreneurial endeavors and innovations end in success (Klimas et al., 2020). Entrepreneurial failure, where entrepreneurs fail to realize their expectations, affects them economically, psychologically, socially, and emotionally (Klimas et al., 2020). Entrepreneurial failures could occur due to environmental and organizational factors, as well as psychological factors of the entrepreneur (Khelil, 2016). Moreover, in a farming context, not all farmers may intend to be entrepreneurial. Entrepreneurial behaviors and intentions in farming differ based on operating contexts such as access to resources, constraints, challenges, and farm characteristics, and are guided by individuals' expressive, social, and intrinsic values, and identities (Austin et al., 1996; Niska et al., 2012; De Bernardi & Pedrini, 2020).

Agricultural Entrepreneurship in the Northeastern US

According to Sassenrath et al. (2010), in the Northeastern US, farmers exhibit entrepreneurial behavior by displaying an active role in determining contract terms, being aggressive in developing new markets, and bearing risks (Sassenrath et al., 2010). Multi-generational farms in the Northeast tend to explore alternative production options and encourage change to provide for a growing family by bringing expertise in new technologies, developing strategies with calculated risks, and diversifying farming enterprises, even in the midst of long-held beliefs of management practices that could hinder the adoption of new technologies (Sassenrath et al., 2010). They are also seen to take an active and broader approach in gathering information by cultivating strong ties with university, extension, and federal scientists,

and hence displaying the entrepreneurial spirit and aggressive approach to learning (Sassenrath et al., 2010).

In Vermont, with the reduction of small and medium-scale farms, certain farms have sought to ensure their survival through diversifying operations, by incorporating goat and sheep on the farm, vertically integrating to carry out milk processing for value-added production of milk such as cheese, yogurt, and kefir, and also providing consultation services (Hall, May 2022; Reiley and Murphy, December 2022). Certain farms also cater to niche and specialty markets, bringing a better return to their milk, especially through branding and marketing their products (Hall, May 2022). Beef production, being smaller in volume to dairy production, fares well with producers catering specialty breeds and cuts to smaller buyers in niche and specialty markets (Thompson, December 2022). Small farmers shifting to organic production in Vermont, is also an entrepreneurial activity that is largely observed in recent decades, that could give farmers a competitive advantage and a higher premium for their milk in the market (Hoffer, 2021; Kardashian, May 2023).

In the New England region, even though tourists directly consume less than 10% of the regional dairy produce, agritourism plays a major role in sustaining producers in other ways, in promoting producers' brand, attracting new customers, providing supplemental income, providing employment opportunities, providing authentic experiences, showcasing their conservation efforts, and highlighting their family pride and heritage (Paras et al., 2022). Small farms, although motivated to adopt new and sustainable management practices, are also more likely to lack the resources, time, and knowledge necessary for such innovations (Neher et al., 2022).

Theory of Planned Behavior

The Theory of Planned Behavior (TPB) extends from the Theory of Reasoned Action and consists of the central factor of individuals intention to perform a certain behavior (Ajzen, 1991). Ajzen (1991) further states that intentions are assumed to capture the motivational factors that influence a behavior in terms of how hard people are willing to try and how much effort they are planning to exert, to perform the behavior. Performance of certain types of behavior also depends on non-motivational factors such as resources and opportunities, that include, but are not limited to, time, money, skills, and cooperation of others (Ajzen, 1991).

The TPB postulates that any volitional behavior can be predicted by three antecedents: attitudes towards behavior, perceived behavioral control, and subjective norms (Ajzen, 1991). Attitudes towards behavior is the degree to which a person has a favorable or unfavorable evaluation of the behavior, subjective norms refer to the perceived social pressure to perform or not perform the behavior, whereas, perceived behavioral control refers to the perceived ease or difficulty in performing the behavior (Ajzen, 1991).

Entrepreneurial behavior in farming is affected by entrepreneurial attitudes either directly, or indirectly, through entrepreneurial intentions, and the stronger the entrepreneurial attitude, the stronger the entrepreneurial intention, and therefore the entrepreneurial behavior (Dong et al., 2022). Innovation, risk-taking, and opportunity-seeking are entrepreneurial attitudes that predict entrepreneurial behavior (Rosairo & Potts, 2016). Innovations in agriculture support the transition to sustainable food systems and harness technological advances, where entrepreneurial-minded farmers are co-creators and informed-users of these developing and future technologies (Yoon

et al., 2021). Risk-taking is also another dimension of agricultural entrepreneurial orientation (Pindado & Sánchez, 2017).

Entrepreneurship itself is the pursuit of opportunities irrespective of existing resources, and such opportunity-seeking attitudes would distinguish potential entrepreneurs, leading to cultivating intentions of entrepreneurial behavior (Krueger, 1994). The willingness to carry out entrepreneurial activity is a combination of personal attitudes as well as subjective norms, which are influenced by family and the cultural context as well (Ozaralli & Rivenburgh, 2016; Doran et al., 2020). Ajzen (2002) relates how perceived behavioral control can be considered similar to self-efficacy. People exhibiting high levels of self-efficacy typically perceive that they can effect change (Bandura, 2017), and self-efficacy mediates the relationship between personality traits and entrepreneurial intention (Wang et al., 2016).

From a psychological perspective, farmers displaying entrepreneurial behaviors are also expected to differ based on their values. Farmers' values can be classified as instrumental, social, expressive, and intrinsic (Niska et al., 2012). Instrumental values imply that farming is performed as a means of obtaining an income, social values imply that farming is performed for the sake of interpersonal relationships, expressive values imply that farming is a means of self-expression, whereas intrinsic values imply that farming is treasured because it enables independence and a specific way of life (Gasson, 1973). Niska et al. (2012) investigates the values of farmers that display entrepreneurial behavior in comparison with those of peasant farmers. While peasant farmers possess social, expressive, and intrinsic values, entrepreneurial farmers are mainly guided by instrumental values, but also possess expressive values by being autonomous and independent (Niska et al., 2012).

In extensions of the TPB, personal, demographic, and environmental factors are considered as antecedents of entrepreneurial behavior (Ozaralli & Rivenburgh, 2016), which has been extended through prior seminal works that emphasize the predictive role of personal characteristics and contextual factors in entrepreneurial behavior (Bird, 1989; Ajzen, 2005). Studies about the adoption of technology, management practices, and production systems in the US dairy and beef sectors have identified the influence of the scale of the farm, farmer income, land tenure, region of the farm, education, and experience of farmers on management and adoption decisions in the farm (Khanal et al., 2010; Pruitt et al., 2012). Khoshmaram et al. (2018) have found that human capital, such as knowledge and experience, social capital, such as strong ties and weak ties, and environmental support have a significant effect on entrepreneurial behavior, whereas Deakins et al. (2016), have identified the role of institutional support on influencing entrepreneurial skill.

These studies are further reinforced by studies conducted internationally across various sectors as well, in that, experience, organizational participation, land holding, income, type of farming, material possession, market orientation, knowledge, access to information and experts, extension consultation, and training influence the entrepreneurial behavior of farmers (Patel et al., 2014; Chaurasiya et al., 2016; Rosairo & Potts, 2016; Paudel et al., 2022). Although the cited literature has not found a significant influence of gender and age on entrepreneurial behavior, numerous qualitative studies have indicated how entrepreneurial behavior and technology adoption vary based on these factors, particularly how challenges related to entrepreneurial behavior are exacerbated for women, and also how young farmers display more innovative and entrepreneurial behavior than older farmers in diversification and technology adoption (Sassenrath et al., 2010; McGuire et al.,

2022). Farmers' perceptions about climate change influence their attitudes towards risk-taking and technology adoption (Legault et al., 2019; Snyder et al., 2019) as well. In this study, we employ the TPB to investigate the entrepreneurial behavior of small and medium-scale livestock farmers in Vermont, and what psychological, demographic, and socio-economic factors are associated with these entrepreneurial behaviors.

Methods

The study uses a mixed methods approach with both qualitative and quantitative research components to address the research questions in investigating in what ways do small and medium-scale livestock farmers exhibit entrepreneurial behaviors, and what factors are associated with these entrepreneurial behaviors. The TPB serves as a guiding theoretical framework in investigating farmers' psychological attributes in engaging in entrepreneurial behaviors and what other factors are associated with these attributes. This study was a qualitative-dominant study where the qualitative data were the core component, while quantitative data supplemented the core component (Schoonenboom & Johnson, 2017). We designed this study using mixed methods to complement and elaborate the findings to improve the reliability and validity of the results, as well as contextualize the quantitative study findings to provide richer and more meaningful conclusions (Schoonenboom & Johnson, 2017). The study was structured as a concurrent design, where the qualitative (QUAL) and quantitative (QUAN) data collection occurred simultaneously and independently of the other (Schoonenboom & Johnson, 2017). Therefore, we integrated the two study components at the results stage to formulate comprehensive findings to illustrate the TPB and its application to the entrepreneurial behavior of livestock farmers in

Vermont more comprehensively. The qualitative component of this study contributes to the growing body of literature around TPB studies that use qualitative approaches, which has been unconventional for the application of TPB (Velardi et al., 2023). However, Glanz et al. (2008) indicate the importance of interview data in the application of the TPB to understand in-depth the factors that relate to a certain behavior. The mixed-methods research design employed in this study is illustrated in Figure 2.

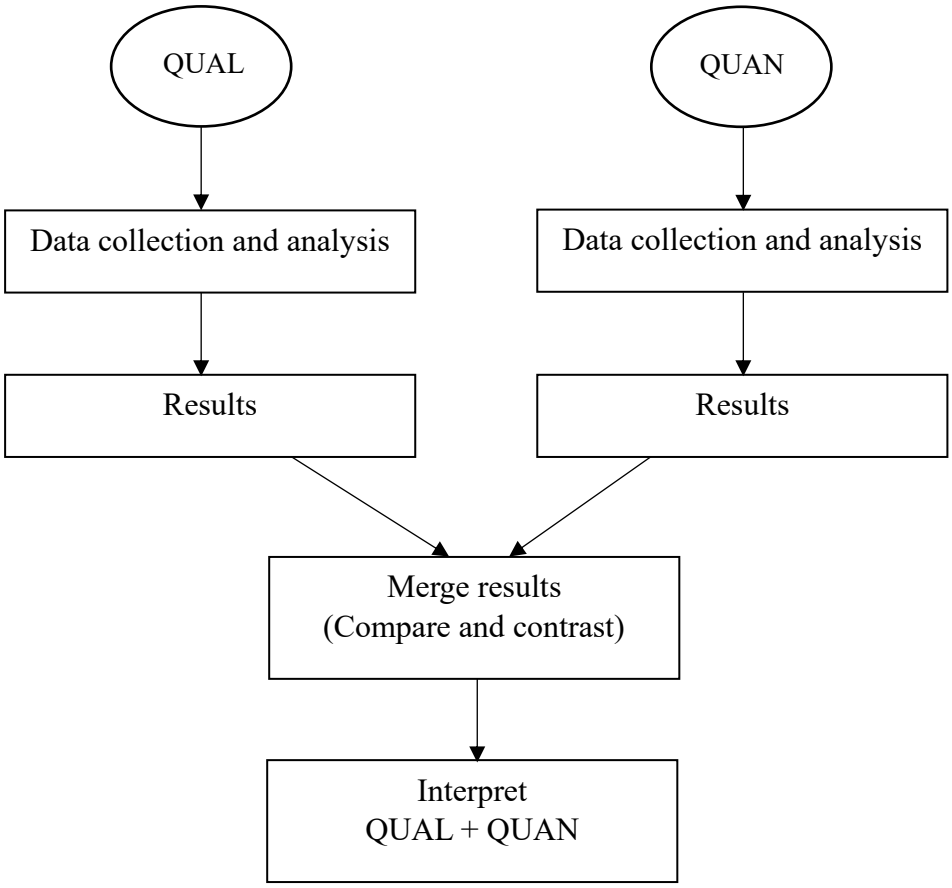


Fig. 2. Convergent Parallel Mixed-methods Design

Qualitative Research

For the qualitative research component, we conducted in-person in-depth interviews with 15 small and medium-scale livestock farmers in Vermont that had operation sizes

less than 600 acres and herd sizes less than 699 animals (Vermont Agency of Agriculture, Food, and Markets, 2015). These farmers were identified through convenience sampling through the USDA Conservation Innovation Grant (CIG) Project "Managing Pasture for Healthy Farms and Soils Across Vermont". The identified cohort of farmers for this study were participants of the USDA CIG project that implements a financially incentivized pasture and soil health management system for improved livestock production on enrolled farms. This study was approved by the University of Vermont Institutional Review Board (IRB) for qualitative data collection. We conducted in-person interviews during the months of November and December 2023 and each interview lasted approximately 30 minutes to one hour. We used both open-ended and close-ended questions in semi-structured interviews with these farmers. The interviews contained questions framed around the TPB and hence inquired into farmers' entrepreneurial behaviors, intentions, entrepreneurial attitudes, perceived behavioral control, and perceived social norms. We also asked questions to inquire about farmers' decision-making, motivations in farming, long-term goals, factors that influence decision-making in farming, as well as risks, barriers, and challenges they face in farming activities. How these questions are operationalizing different constructs in the TPB are represented in Table 1. We recorded all interviews with the permission of the interviewees and transcribed the voice notes with the transcription software 'Cockatoo'.

We analyzed each interview using NVivo software and used an *a priori* coding framework based on TPB complemented with open coding to allow data to express itself. We first developed *a priori* codes using the TPB constructs and identified emergent main ideas and themes through the data. The resulting main codes and sub-codes were grouped and categorized under the main themes of the TPB

(entrepreneurial behaviors, intentions, attitudes, perceived behavioral control, perceived social norms), as well as farming values, and challenges and risks (Velardi et al., 2023). In data analysis, we present in-depth the factors that are associated with farmers' entrepreneurial behaviors and also how they are associated with other factors such as farmers' demographic characteristics and farm characteristics.

Table 1
Questions from semi-structured interviews to operationalize components of the TPB

TPB Component	Operationalization
Entrepreneurial behavior	Do you consider yourself an entrepreneurial farmer? Can you explain why?
Intentions	What are your long-term goals as a farmer? (follow-up with prompts)
Attitudes	What keeps you motivated to farm? How willing are you to take risks on your farm to explore new opportunities? How open are you to adopting new farming technologies and practices? In your understanding, what does it mean to be entrepreneurial in farming?
Perceived behavioral control	How confident are you in your ability to make strategic decisions that will help you achieve your farming goals?
Perceived social norms	How much do you think the behaviors of other farmers in the community influence your own farm management decisions?
Other factors that may be associated with entrepreneurial behavior and TPB constructs	What factors mainly influence your decision-making in farming? How do you view your relationship with farming? What are some of the biggest risks you face in farming? How do you remain resilient in the face of these risks?

In the interviewed cohort of farmers, a majority (60%) identified as male (n = 9), while the rest identified as female. Out of the 15 farmers, four were couples who were managing the livestock operation together, while two were family-run operations managed by the father and children, and the rest were individually run operations, where labor was provided by the family and other hired employees. The mean age of the interviewees was 42.4 years (SD = 9.7 years; range: 28-59 years old). The farming

experience of the interviewees in terms of the number of years that the respondents have been farming varied considerably as well, where the average years of farming experience was 17.9 years (*SD* = 9.0 years). The most experience was 43 years, and the least experience was 7 years. Out of the 15 farms, six were dairy operations (40%), five were beef operations (33.3%), and the rest (26.7%) were co-species farms that raised a mix of cattle beef, sheep, and goat as livestock. The average farm size of the cohort was 245.4 acres (SD = 165.1 acres), with the smallest farm having 25 acres and the largest 544 acres. In the sample, there were 10 farms (66.7%) that were small-scale in terms of the farmland (≤ 250 acres) and five farms (33.3%) that were medium scale in terms of the farmland (> 250 and ≤ 600 acres). All these farms were classified as small or medium scale according to the definition of the Vermont Agency of Agriculture, Food, and Markets (2015) where every farm had a herd size of not more than 699 animals.

Quantitative Research

For the quantitative research component of this mixed-methods study, we developed a structured online survey to be disseminated to a sample of 120 small and medium scale livestock farmers in Vermont. Since there was no formal list of small and medium scale livestock farmers in Vermont, it was not possible to conduct probability sampling due to the unavailability of a sampling frame. Therefore, we conducted convenience sampling to identify a sample of farmers to participate in this study. We contacted the Northeast Organic Farming Association of Vermont (NOFA-VT), Vermont Grass Farmers' Association, Northeast Pasture Consortium, and the Vermont Goat and Sheep Association to recruit farmers for this study through their email listservs and e-newsletters. The online survey was prepared through Qualtrics and

approved by the University of Vermont IRB before being disseminated through the above organizations' communication media. Since this survey was advertised through newsletters and emails, we anticipated a low response rate compared to other direct survey methods. However, we offered an opportunity to win a raffle-draw prize as compensation for participating in the survey, to appreciate farmers for their time and effort, as well as to improve the response rate.

We prepared survey questions framed by the TPB and included measures on demographic characteristics and farm characteristics as well. We obtained these measures from validated scales by previous studies and integrated scales of the same construct presented by several authors to produce comprehensive scales for this study. Prior to dissemination to the sample of farmers under study, we pre-tested the survey using various methods. First, we conducted a cognitive interview with a small-scale farmer in Vermont to test the face validity of the survey. The in-person cognitive interview lasted 30 minutes, where the farmer read through the survey and discussed strengths and weaknesses of the structure and order of questions in the survey. The interviewee provided recommendations to improve the wording and phrasing of certain questions, and recommended addition and deletion of some questions. After ensuring the face validity of the survey, we programmed the survey through Qualtrics, and pilot tested. For the pilot test, we identified 21 respondents, including farmers and agriculture students to participate in the survey and sent them the survey link through email and text messages. The pilot test ensured the smooth running of the survey and the data obtained from the pilot test allowed for some preliminary analytical tests to be conducted. From the pilot test data, we tested the construct validity of the survey scales using Exploratory Factor Analysis using Stata 17.0 software. In addition, we tested the reliability of these scales using Cronbach's alpha. Each of these scale

measures had five-point Likert scale responses. The description of each scale, scale validity and reliability are explained in detail below.

Entrepreneurial Behavior

The measure of entrepreneurial behavior consisted of 14 items. This scale was adapted from the entrepreneurial behavior scales presented by Agbolosoo & Anaman (2021) and Colémont & Van den Broucke (2008). This scale consisted of items that inquired if farmers engaged in entrepreneurial behaviors such as information seeking, diversification, technology adoption, experimenting and innovating, adopting sustainable management practices through research and development, knowledge-sharing and networking. The reliability of the scale was tested using pilot test data, and the Cronbach's alpha was found to be 0.7513, indicating satisfactory internal consistency. The factor analysis found 4 factors in the scale having eigenvalues above 1.00. However, since factor 1 explained 32.55% of the variation of the scale, it can be thought to be having one primary factor that explains a considerable variation of the scale, i.e., entrepreneurial behavior.

Entrepreneurial Intention

The measure of entrepreneurial intention consisted of 6 items. This scale was adapted from the scale presented by Colémont & Van den Broucke (2008). The items of this scale inquired into farmers' future entrepreneurial intentions, whether they would diversify, change their management practices towards more regenerative management, adopt more technologies, employ certification schemes, participate in research and development programs, and cater to additional markets in the future. The Cronbach's alpha of the scale was 0.7054, indicating satisfactory reliability. The factor analysis revealed 2 primary factors in the scale having eigenvalues above 1.00. Since factor 1

explained 63.69% of the variation of the scale, this measure can be said to exhibit satisfactory construct validity in explaining the entrepreneurial intention construct.

Attitudes

The measure of attitudes contained 6 items that were adapted from the scales presented by Colémont & Van den Broucke (2008) and Kumar & Ratnakar (2016). This scale operationalized attitudes of farmers towards entrepreneurial behaviors, on a five-point Likert scale if they agreed or disagreed with the uses, benefits, or importance of entrepreneurial activities such as diversification, innovation, regenerative practice adoption, and technology adoption. The Cronbach's alpha was satisfactory at a value of 0.7438. The scale displayed a high construct validity with the presence of 1 factor that explained 85.90% of the variation of the scale in measuring attitudes.

Perceived Behavioral Control

The measure of perceived behavioral control contained 6 items that were adapted from the scales presented by Colémont & Van den Broucke (2008), Pino et al. (2017), and Liang & Chen (2021). The items of this scale inquired into farmers' self-efficacy or perceived behavioral control in engaging in entrepreneurial activities, inquiring into their confidence and ability to manage risks, experiment and innovate, adopt technologies and new practices, and network and cooperate with others. The reliability of the scale was fair, with a Cronbach's alpha value of 0.5910. However, the measure presented high construct validity with the presence of 1 factor that explained 75.66% of the variation of the scale, as tested through factor analysis.

Perceived Social Norms

The scale that measured perceived social norms consisted of 6 items that were adapted from the scales presented by Colémont & Van den Broucke (2008) and Pino et al. (2017). This scale had items that operationalized farmers perceived social norms by inquiring into how family, community, other farmers, and society expectations influenced their entrepreneurial behaviors. The reliability of the scale was also fair, but not satisfactory with Cronbach's alpha value of 0.6809. The scale was found to have satisfactory construct validity with the presence of 1 factor that explained 60.97% of the variation of the scale, that can be determined as the factor that explains perceived social norms.

In addition to the above TPB components, we also inquired into specific farm characteristics such as the number of years of operation of the farm, type of livestock operation, farm acreage, herd size, market products, number and types of employees on the farm, farm infrastructure, management practices on the farm, farm certifications, insurance schemes, the use of computerized decision support tools, sales and marketing avenues, if the farms are diversified or if the farmers engage in other off-farm income streams, the average annual income from livestock products, perceived farm viability, factors that influence decision making, and challenges and barriers that most likely affect the viability of the livestock operation. In addition, we also inquired into farmers' demographic characteristics such as age, gender, average annual household income, and highest level of educational attainment. We disseminated the survey in May 2024, and at the time of writing received 28 responses where only 18 responses were fully completed through the end, which was much lower than the anticipated response rate. Due to the very small sample size, we conducted simple statistical analyses for the quantitative data of this study to supplement the qualitative findings to inform the mixed-methods study.

In the surveyed sample of farmers, a majority (50.0%) identified as male (n = 9), while 44.4% identified as female (n = 8), with one farmer preferring not to respond. The mean age of respondents was 59.1 years (SD = 15.7 years), where the oldest farmer was 99 years and the youngest was 36 years. In the cohort of farmers 83.3% (n = 15) had received a college degree or an equivalent such as an associate's degree. A majority of 58.8% of farmers in the sample (n = 10) reported earning an average annual household income between $25,000 and $75,000, with some farmers (n = 5) earning above $100,000 as well. Regarding the farm characteristics, 14 farmers were sheep producers, four were dairy producers, four were goat producers, and three were beef producers. In addition, several farmers also produced poultry, pigs, rabbits, horses, bees, and alpacas. The mean farm size across the sample, including both owned and rented land was 150.1 acres (SD = 151.1 acres), where the smallest farm size was 21 acres and the largest was 615 acres. The surveyed farmers fall under the definition of the Vermont Agency of Agriculture, Food, and Markets (2015) for small and medium-scale farms based on the herd size where every farm had a herd size of beef, dairy, sheep, or goat less than 699 animals. For all farms, farm labor was provided by the family, where male farmers (n = 21), and female farmers (n = 15) both provided family labor to the farm. In addition, six farms also employed one hired employee each to work on their farms. A 50% of the farms (n = 10) have been in production between 10 and 20 years, where some farms (n = 2) have been farming less than five years, and some (n = 1) have been farming over 40 years as well. These descriptive statistics are further represented in Table 2.

Table 2
Socio-demographic profile and farm characteristics of the farmer sample

Variable	Mean	Standard Deviation	Frequency (n)	Percentage (%)
Demographics				

Age	59.13 years	15.67 years		
Gender				
Male			9	50.00
Female			8	44.44
Prefer not to say			1	5.56
Education				
Less than high school graduate			1	5.56
High school graduate or equivalent			1	5.56
Some college, no degree			1	5.56
College degree or equivalent			15	83.33
Annual Household Income				
Less than $25,000			1	5.88
Between $25,000 and $50,000			5	29.41
Between $50,000 and $75,000			5	29.41
Between $75,000 and $100,000			1	5.88
Between $100,000 and $150,000			3	17.65
Between $150,000 and $200,000			1	5.88
Over $250,000			1	5.88
Farm Characteristics				
Livestock Type				
Beef			3	12.00
Dairy			4	16.00
Sheep			14	56.00
Goat			4	16.00
Farmland Size				
Owned	99.20 acres	129.84 acres		
Rented	47.07 acres	43.64 acres		
Herd Size				
Dairy	134	37		
Sheep	116	70		
Goat	193	266		
Beef	-	-		
Farm Labor				
Family				
Male			21	50.00
Female			15	35.71
Hired			6	14.29

Production Years		
Less than 5 years	2	10.00
Between 5 and 10 years	5	25.00
Between 10 and 20 years	10	50.00
Between 20 and 30 years	1	5.00
Between 30 and 40 years	1	5.00
More than 40 years	1	5.00

Results and Discussion

Qualitative Findings

We structure the qualitative results under the main emergent themes related to the constructs of the TPB (entrepreneurial behavior, intentions, attitudes, perceived behavioral control, perceived social norms), and other factors that emerge as main themes (challenges and risks, and opportunities to enhance resilience) that have associations with farmers' entrepreneurial behaviors. The *a priori* coding framework developed based on the TPB, complemented with open coding. We classified these data under main themes and categorized various sub-themes together guided by existing classifications related to entrepreneurial behaviors of farmers as present in literature.

Entrepreneurial Behavior

A variety of entrepreneurial behaviors emerged from the data, and they were classified under four main categories based on prior literature. These four types of entrepreneurial behaviors were On-farm diversification entrepreneurs, Innovative entrepreneurs, Eco-entrepreneurs, and Pluri-active entrepreneurs. These categories were not mutually exclusive; one farmer could exist in only one or even several of these categories based on the types of entrepreneurial activities they engaged in.

On-farm diversification entrepreneurs were classified according to behaviors that farmers displayed in that they catered new products to the market, introduced their products to new markets, engaged in value-added production, diversified their operations on the farm, and introduced new businesses on the farm that are non-livestock as well. This classification was guided by prior literature by Carter (1998), Eikeland & Lie (1999), McElwee (2008), and Niska et al. (2012) that defined on-farm diversification as an entrepreneurial behavior that farmers engaged in to broaden their production, expand operations, and strategically orient to changing market and environmental conditions.

This also aligns with the findings of Liang (2011) that highlight on-farm diversification as a multi-functional approach that farmers engage in for long-term sustainability and enhanced resilience. Diversifying into additional related agricultural enterprises, having new business on the farm related to agriculture and non-agriculture such as tourism, adding value to conventional farm products, introducing unconventional farm products, identifying niche markets to provide products and services, producing new goods and services, and engaging in agritourism and specialty food production are diversification activities on farms (Slee, 1987; McElwee & Bosworth, 2010; Liang, 2011). These definitions and categorizations were used to categorize farmers' entrepreneurial behaviors under the theme 'On-farm diversification' in this study.

Innovative entrepreneurship, although closely related to diversification entrepreneurship, was classified as a separate category based on its distinct characteristics. In this category, farmers displayed behaviors towards innovation and experimentation, that was not necessarily aimed at diversification, and engaged in new technology adoption. These behaviors consisted of modifying farming activities

through trial and error, doing things differently while being willing to change, and striving for continual improvement through experimentation. Farmers who displayed innovative entrepreneurial behaviors also displayed the adoption of new technologies such as new fencing infrastructure, innovative electrical systems, virtual fencing collars, and computerized decision support tools or mobile applications for grazing animals and making hay bales.

These behaviors that fall under the theme of 'innovative' were also highlighted in prior studies of agricultural entrepreneurship. McElwee (2008) categorizes farmers who have high technological orientation and who use advanced technologies as entrepreneurial and innovative farmers. Dias et al. (2019) describe how farmers display innovative behaviors by adapting to new changes, strategically and creatively using and integrating limited financial and local resources and employing innovative methods and technologies that improve resource use efficiency on their farms. Similar to the study conducted by McElwee (2008), the cohort of farmers in this study who engaged in innovative behaviors also displayed using farm resources and features in flexible and innovative ways through experimentation and trial and error.

The third theme of entrepreneurial behavior that emerged from the study was 'Eco-entrepreneurship'. This type of behavior was distinctly focused towards being innovative and entrepreneurial towards ecological sustainability and ecosystem restoration. Farmers who engaged in such behaviors displayed changing established management practices and implementing new practices on farms geared towards environmental sustainability and regeneration. Farmers adopted and implemented the practice of rotational grazing; a regenerative pasture and soil health management practice for ecosystem restoration (Giller et al., 2021). Some dairy farmers incorporated other animals such as goats on their land to improve fertility on their

lands by grazing them on pastures. Farmers also implemented keyline plowing and re-seeding for improved pasture diversity as a cover crop practice on grazed pastures.

Regenerative management, agroecological intensification, and low-input production were key themes that emerged across the cohort of farmers in this study related to eco-entrepreneurship. These activities on farms were displayed with the use of management intensive rotational grazing practices and implementing agroforestry and silvopasture by farmers on their lands. Some farmers also exhibited a conversion and transition from a conventional farming model having confinement feeding operations or continuous grazing practices to a more sustainable livestock operation that uses intensive grazing management.

De Bernardi & Pedrini (2020) too studied entrepreneurial behaviors of agricultural producers geared towards environmental sustainability with the use of environmentally-friendly practices and further classified producers as eco-sober, eco-tipsy, and eco-drunk based on the intensity of their environmental identity and passion. Indaco-Patters et al. (2013) described ‘ecopreneurs’ as those that promoted a change in business vision based on exploitation of natural resources towards ecological preservation. Similarly, Mieszajkina (2016) described eco-entrepreneurs as those that use environmentally-friendly technologies, use natural resources sparingly, adopt technical measures to conserve resources and produce less emissions, including farmers that use environmental best practices, improve and restore ecosystems, and farm with a heightened environmental awareness as those that emerged through the themes of this study as ‘eco-entrepreneurs’.

Lastly, a final category of entrepreneurial behaviors that emerged through the data was classified as ‘Pluri-active entrepreneurs’. Farmers that displayed this type of

entrepreneurial behaviors engaged in other businesses other than farming and had off-farm income streams to supplement their farm income (McElwee, 2008). This type of entrepreneurial behavior can also be called ‘income diversification’ (McElwee, 2010) or ‘portfolio entrepreneurship’ (Vesala and Peura, 2003).

Few farmers in this study displayed pluri-activity by engaging in other enterprises such as coaching businesses, consultation services, and extension service provision. One farmer also had an unrelated industry job as a lawyer and engaged in farming part-time as an additional income source as well as a hobby. Studies emphasize that farmers who exhibit such behaviors are more market-oriented and employ complex managerial strategies but may lack an inner motivation or sense of identity as a farmer (Carter, 1998; Vesala and Peura, 2003). These notions are discussed more in the subsequent sections.

The emergent four typologies of entrepreneurial behaviors, their sub-themes, and examples of farmers’ narratives for each theme are represented in Table 3.

Table 3
Emergent Themes of Entrepreneurial Behaviors

Theme (Entrepreneurial Behavior Type)	Sub-theme	Example
On-farm Diversification Entrepreneurship (n = 10)	Catering new products Catering to new markets On-farm diversification New businesses on farm	*This farm is very entrepreneurial. Like I would say it’s really multiple businesses operating as one business. And actually, not even one that's operating. Currently, it's three businesses*. (P2, male, beef producer) *If you're like myself, who must figure out these market channels beyond making the production technician level system, I feel like that's where new product lines emerge. Somebody who's just emptying their bulk tank and it gets on a truck, they're not worried about what that product is*

		making, but I've got to figure out how to merchandise a beef cow or a pig or a lamb to maximize the dollars out of it to make the whole system work. (P3, male, beef producer) *I shouldn't say I farm full-time. I do not necessarily produce agricultural products as the primary portion of my business income at this point. So, my farm business is actually a farm stay, agritourism business predominantly, and a bit of an outreach business as well*. (P5, female, sheep producer) *We make seasonal value-added products on this farm. We're going to make maple milk – an innovative product, maybe producing it next season. We sell through specialty stores in Boston and New York*. (P11, male, dairy producer)
Innovative Entrepreneurship (*n* = 10)	Experiment and innovate Technology adoption	*There's always something you can improve. When you leave the farm, you see something new. You're like, oh, I want to come back and try this out here. So, I think it's that kind of quest, that continual improvement*. (P13, male, dairy producer) *There's a whole computer system to our baler now. And like that, it shows you the whole, the bale on the inside, how much hay is on one side of the bale versus the other side. So, I remember earlier when I was working with my dad, the bales would come out and they would all be like this on one end and this on the other. But now we can make an even bale*. (P1, 2nd generation farming daughter, beef producer) *I experiment a lot. I just try to control the size of my experiments, so that I know it's safe to fail. So, I'll assume it will fail and it's all okay*

		that it fails. (P2, male, beef producer)
Eco-entrepreneurship (*n* = 10)	New practices and changing management towards more sustainable and environmentally friendly Regenerative management Low-input production Transforming from conventional to rotational grazing operations	*I think what we're doing here is reestablishing old-growth communities that have been heavily disturbed over the last few centuries. I think this farm is a really beautiful story with that, of going from the last generation of conventional dairy farms and moving into something really innovative, like a woman-led and owned farm, like that alone, something that is amazing*. (P2, male, beef producer) *Every inch of our farm is all productive. We have diverse species – maples and wildlife. We also have goats on the land now and they make unusable areas usable now. Earlier a lot of things were done with horses. There's no reason you can't go back, back into low inputs*. (P8, farming couple, dairy producers) *Ecological land management, for me like continuing to improve the quality of the pastureland and ecosystem is important to me*. (P14, female, beef & sheep producer)
Pluri-active Entrepreneurship (*n* = 4)	Off-farm income streams	*The whole reason dad bought the tractor trailer truck was so that we, because there's not enough income off the cows and the sugaring to support both of us. So that's really why he bought the trailer truck so that he can step away and have a separate income*. (P1, 2nd generation farming daughter, beef producer)

Entrepreneurial Intentions

All the farmers in the sample exhibited entrepreneurial intentions, respective to the different types of entrepreneurial behaviors that they exhibited as described above. This agrees with the seminal literature by Ajzen (1991) in explaining how behaviors could be predicted through intentions that an individual has towards that behavior. Some farmers displayed clear diversifying intentions towards value-added production, product diversification: transitioning from dairy to beef and adding new agricultural businesses on the farm such as horses, income diversification (pluri-activity), and agritourism.

A current dairy farmer (P11) who produces regionally well-known value-added products expressed,

"*I don't want to be always tied to dairy. The business model is tied to dairy right now and lots of investments in infrastructure have gone towards dairy. There's an option to divert from dairy to beef*."

Although this farm gains high value through the value-added and seasonal products such as cheeses and yogurt they market to niche markets, the farmers were concerned about the current instability of the milk market and the low prices they receive for milk. With changing consumer demand and lifestyle where people drink less milk, this farmer was opting for diversifying his business to include beef production as well, thereby not relying solely on one enterprise as his income source. The same farmer (P11) expressed how adopting technologies may serve as a strategy to stay resilient in the volatile business environment they operate in, indicating,

"*I want to move towards a bigger scale in the future, with technology and automation on a larger scale. I'm thinking of getting activity collars or GPS collars, maybe that is*

a way to be resilient for big farms. I also want to see more apps and technologies used in farming."

Similarly, another dairy farming couple (P12) expressed similar sentiments regarding the unstable milk market and how they were hoping to further diversify their farm in the future to remain resilient and viable. They expressed,

"*We want to grow the horse-side of the business and diversify towards more agritourism focused, without depending on one business. We don't want to just depend only on dairy*."

In contrast to dairy farmers, beef farmers did not exhibit intentions towards product diversification, but rather an intent towards market diversification and expanding their current operations to reach more beef markets and high-end customers. A beef farmer (P15) who also has a separate day job said,

"*I'm interested in creating a whole business model, which would be pretty high-end custom beef and run it as a cooperative where we can do custom slaughter without stressing animals*."

However, this farmer was also limited by infrastructure such as freezers and refrigerators that was challenging him towards reaching this goal.

Farmers also expressed intentions towards eco-entrepreneurship in terms of employing more regenerative practices and environmentally sustainable operations to attain higher value and remain resilient. A dairy farmer (P13) said,

"*Well right now I put an offer on my neighbor's farm that's right across the road there, so we'd be moving the milking herd there. And this would become the heifer farm. I'd like to move down the road to more labor efficient facilities. The neighbor's farm has*

more grazing acres, so my dream would be to be able to graze all summer and not feed a bale. That's like one of my little goals."

This shows how certain farmers although do not have diversification goals, do have goals towards more regenerative practices such as systematic grazing and have already initiated actions towards the transition from more conventional to sustainable production.

This farmer, a first-generation farmer who got into farming by helping at the farm and doing farm chores, is now taking over the management and ownership of the farm, which can be seen as an unconventional farm succession approach. Talking about his plans for the farm, he expressed how diversifying his business would not solve the market challenge he currently faces which is obtaining a fair price for milk. He (P13) said,

"*Just because your farm's not doing well, diversifying is not the solution. A fair milk price would be the solution. If your farm is failing, like, starting a new different venture is not going to save your farm, it's just going to create a new business. I think so many farms in the area are diversifying, but it's essentially like a recognition that their primary enterprise is no longer profitable, whether that be dairy or something else. And so, you might have multiple agricultural enterprises or like a lot of people have like farm stays or you know other things. That's a great thing to do but I just don't want it to be like the solution to the problem*."

His sentiments were much different to other dairy farmers who were intending to diversify their operations, reflecting that farmers may need other sustainable solutions or strategies as well for the challenges they face to remain resilient.

Attitudes

Entrepreneurial behaviors and intentions seemed to be associated with the attitudes that farmers had towards the kinds of entrepreneurial behaviors they exhibited, as per the TPB (Ajzen, 1991). Farmers displayed a wide range of attitudes towards entrepreneurial behaviors that influenced their practice and intentions towards such behaviors, which were also influenced by their personal values. The main emergent attitudes of farmers towards entrepreneurial behaviors in general were being resiliency focused, low growth minded and resource dependent, efficiency focused, opportunistic and risk-taking, community focused, and liking independence.

Resiliency focused attitudes towards entrepreneurial behaviors emerged through four sub-themes related to being resilient, which were: the need to do something to be resilient with the changing market and environmental conditions, reaching economic stability, being focused on the long-term goals for the farm, and having a fear of failure. Farmers who exhibited diversification intentions expressed how they see diversification as a strategy to remain resilient and not be dependent only on one product or one commodity market. While product or market diversification helped farms enhance business resilience, adopting and implementing regenerative management practices as exhibited by eco-entrepreneurs was reported as a way to remain climate resilient.

Reaching long-term goals of the farm towards economic stability was another motivator for farms to engage in entrepreneurial activities such as diversification. However, these economic goals were not exhibited as extractive or capitalistic market expansion goals, but rather goals towards creating an economically viable operation that can compensate farmers for their labor. Similarly, reaching other long-terms goals for the farms such as creating a viable operation for the next generation was another motivating factor for farmers to engage in entrepreneurial activities that they believe

would enhance their resilience. Farmers were also motivated to engage in entrepreneurial activities by a fear of failure of the enterprise, and although these farmers did not engage in diversification due to a fear of failing and losing resources through experimentation, they exhibited changing management practices and adapting to changing market and environmental conditions as eco-entrepreneurs and pluri-active entrepreneurs to remain resilient.

Some of the farmers' entrepreneurial intentions were influenced by subsistence-based and low growth minded attitudes. These included being less idealistic and settling for safety and security, not growth minded, risk averse, technology averse, and resource dependent. Farmers who used to have high entrepreneurial attitudes and intentions when they started farming related how such attitudes diminished over time as the business progressed and hence their visions became more realistic and grounded under the various resource constraints they faced. Their activities came to be more centered around the resources they had at hand and hence at times operated within a scarcity mindset. Such attitudes made them more comfortable and secure with what they were already doing and knew best to do, such as managing one enterprise like beef or dairy, and not intending to diversify.

Being less growth minded was another attitude that emerged, especially through farmers who displayed strong eco-entrepreneurial and pluri-active entrepreneurial intentions and behaviors. For such farmers, getting out of debt or paying themselves a livable wage were their main economic goals for engaging in farming and entrepreneurial activities. Even for some eco-entrepreneurs who have transitioned from conventional modes of production to sustainable and regenerative methods, grazing has been a practice that they adopted out of necessity due to a lack of resources for labor, equipment, and other infrastructure. Similarly, certain farmers

displayed clear aversion to risks and technologies that inhibited and restricted them from engaging in certain entrepreneurial activities. Prior experiences of farmers who used to experiment, and fail have made them averse to risks and more guarded in taking risks (Klimas et al., 2016). Risk-taking was also seen to be context-dependent where in certain instances where the returns appeared clear, farmers seemed to take more risks. Their risk-taking attitudes were influenced by the type of risk: for example, if it was a big financial risk, they seemed to be reluctant to take it, although were willing to take risks in small amounts such as experimenting with new practices and changing operations on the farm. Moreover, some farmers indicated how technology and the associated learning was a challenge and burden that restricted them from using machines and computerized decision support tools.

Farmers who mainly displayed innovative and technology adoption behaviors exhibited how they were motivated by efficiency focused attitudes to attain better products, improved efficiency in infrastructure and thereby save more time, and to have the business operations streamlined. These farmers also displayed a general aversion for product diversification, indicating that having the business streamlined with one product, and using established infrastructure for producing that product was an efficient business model for them that made them resilient.

There were farmers who were distinct from others who displayed resource dependent and resiliency focused attitudes, in that they exhibited clear opportunistic and risk-taking attitudes, that were displayed through their business models as well. These farmers displayed a growth mindset, liked being innovative, liked adopting new technologies, were opportunistic and less hesitant to take risks, and had a willingness to change. These attitudes were mostly exhibited by farmers who engaged in diversified operations and innovative entrepreneurial activities such as

experimentation, technology adoption, and new practice adoption. Although these farmers generally took risks, they were mostly small risks that they felt secure to take, and not big financial risks outside their level of security. Being creative and generating new ideas were commonly expressed by these farmers as a way that they maintain a resilient entrepreneurial farm.

Several farmers also expressed how their entrepreneurial behaviors were reflected by the attitudes they had towards their community. These farmers were motivated by a need to do something for their community and for their desire to build community through the farm. Diversified operations such as farm schools, cafes, musical events and markets on farms, and reaching new markets through farmers' markets were entrepreneurial activities these farmers engaged in that were rooted within community. While some farmers yearned to farm with and within their community, some others liked the independence of farming and hence disliked being managed or having employees. The emergent themes of attitudes towards entrepreneurial behaviors, with relevant examples, are displayed in Table 4.

Table 4
Emergent Themes of Entrepreneurial Attitudes

Theme (Attitudes)	Sub-theme	Example
Resiliency focused	Doing something to be resilient Fear of failure Focused on long-term Towards economic stability	*I want to get better at the entrepreneurial part because that might help the bottom line*. (P3, male, medium-scale beef producer) *The horse side of the business keeps the business resilient. Not being all corn and soybean keeps the business resilient. Grazing keeps us resilient, mainly to climate variability*. (P12, farming couple, diversified dairy operation) *Continuing to improve the quality of the pastureland ecosystem is important to me,*

		but one of my big goals is to get to the point of being able to pay myself a livable wage, you know, comfortably and compensate for my time and labor. And that would allow us to take time off or have reliable help that I can, like, if I get sick, everything falls down or those types of things. (P14, female, co-species grazing farmer)
Low growth minded and resource dependent	Aversion to technology Going for the safest option Less idealistic Not growth minded Resource dependency Risk averse	*There's too much technology. Way too much going on. I'd much rather be out in the woods. Technology is not my thing. But again, it all depends on what it is. Like, something on my phone, I don't want to do. I hate looking at my phone.* (P1, young female farmer, beef producer) *If I had to do maintenance and not exploration and development in the last 20 years, I would have been more successful. Now I'm doing maintenance. People were making money doing farming earlier, but recently not so much. It doesn't seem worth it to go out of the way to farm. It's more of management for it.* (P6, male, dairy farmer) *I have been experimenting a lot, doing a lot of different things, and burning out on things, wasting a lot of time and money on things, and always kind of knowing, oh, the beef is the safest, most profitable, best-looking thing, why am I trying to do 50 meat chickens, and 400 cannabis plants.* (P10, male, beef farmer)
Efficiency focused	Like having the business streamlined Like the efficiency of infrastructure Better products Need to save time	*When I had too many enterprises, it was all about getting the to-do list done for this enterprise and this enterprise and this enterprise. And they were competing to-do lists. And to have fewer to-do lists, which means fewer enterprises, it means that I have the capacity, just the time and the energy capacity to end the day at a certain time and then go clip some of these seedlings coming up and make observations and plant fruit trees, things like that, manage those*. (P5, female, sheep farmer)

		I have these ideas of what if I did this way and how would that change my pastures or change the ecosystem or have an impact. But to actually have both energy and time and money to be able to do any of those things is so hard. (P14, female, co-species grazing farmer) *I think there's a lot of local food production that can be done if it fits in with a day job. And to me, trying to figure out efficient management, keeping that an hour a day, where maybe your big projects you take on the weekend, the refencing or the big stuff, but the day-to-day management can really be contained to an hour a day. So, part of it is making a manageable day job*. (P15, male, pluri-active beef farmer)
Innovative and opportunistic	Growth minded Like being innovative Like technologies Opportunity-seeking Risk-taking Willingness to change	*Yeah, I experiment a lot. I just try to control the size of my experiments, so it's safe to fail. I'll assume it will fail and it's all okay that it fails*. (P2, male, beef farmer) *Just not getting stuck in the same old paradigm of this is how we've always done it, this is how we do it. Like there's always new ideas, there's always more efficiencies, there's always like the next thing, because all of what we were doing at one point was a new idea, just got stale, or there hasn't been new ideas because it hasn't been accepted, so I'm very open to new ideas.* (P3, male, medium-scale beef producer) *I'm trying to be entrepreneurial even harder. I'm very open to trying a new breed, a practice, or a new technology, while risking small amounts. I want to always learn and move forward and make mistakes in small amounts*. (P4, male, older generation dairy producer) *I love the growth mindset that comes with entrepreneurialism. I think it's a trick sometimes to switch from an entrepreneur to a manager. It's a different kind of business. I'm still working on the switch to being a manager myself. But that*

		entrepreneurial mindset is always about growth and new ideas. And not necessarily growth being bigger. Sometimes it's just doing things differently, but with being willing to change. The growth mindset is always about what is to be learned from this experience in this place. (P5, female, sheep farmer) *Risks are rewards. If there is a risk, formulate a plan. Milk prices force you to be productive and make changes – that's an opportunity. Adapt to the risks, can do something with this land. There is some product that someone wants that can be made from this land*. (P8, female, dairy farmer)
Community focused	Like building community Like doing something for the community	*Apart from that economic piece, it's like building community and building relationships that come with having the cafe, the educational program. The synergy is amazing*. (P2, male, beef farmer) *I already had a connection with many of those customers just having like grown up at the farmers market stand and on the farm. Knowing a lot of these people and being able to start and kind of build off of my parents' farm's customers and their relationships really gave me a huge boost in building my own brand*. (P14, female, co-species grazing farmer)
Like the independence	Dislike being managed Dislike having employees	*I'm taking a generational next class, I did the first class yesterday, but I was like, this is stupid. It was my opinion on it yesterday. But yesterday they just went over having employees on the farm. Like, I don't ever plan to have an employee*. (P1, young female farmer, beef producer)

The attitudes farmers had towards being entrepreneurial elicited the values they were guided by in their farming activities. In addition, conversations about farmers' history in farming, their long-term goals, motivations and decision-making in farming portrayed their values and how such values influenced their attitudes as well. Farmers

displayed mainly social, ecological, expressive and intrinsic, and instrumental values that influenced the types of entrepreneurial behaviors they exhibited.

Social values were displayed through deep connections and relationships with community, customers, employees, and family and children. For some farmers, the values of their entire farming operation were mainly social, where employees were hired by the community, and children were raised on the farm within community that was building a multi-generational farm. One such farmer (P2) said,

"*Farming is a harder work for me, because I think farming is really focused on production, and I think we do, we like produce to feed our community very directly, and I think that's amazing and wonderful we're able to make those connections and linkages*."

They were also supporting the broader community through educational programs, summer camps, and farm schools. Similarly, many farmers (more than half of the farmers in the study) were innovating and experimenting on their farms to retain a self-functioning and viable operation for the future generation, mainly their children. There were several farmers whose entrepreneurial activities were highly motivated by their employees' happiness. For these farmers, having efficient operations with well-established infrastructure, equipment, and machinery was important for their employees' wellbeing.

From a market perspective, for several farmers, the appreciation and admiration from customers was a very high motivating factor to innovate and cater their products to additional markets. Such farmers attempted to serve a higher value than the market value of their products or services to customers, may it be relationships, community,

or even good health. A sheep farming couple (P5) who also engage in agritourism through farm stays and farm recreational programs expressed,

"*Somebody was calling me on my vision and my mission, which has been connecting the world through food, family, and farm, for a number of years now. He said, "What are you really?" He finally helped me refine it into, we're a working farm where people come to heal. They can heal through our food, they can heal by staying here, reconnecting with each other. Healing is a big part of what Tom, and I are doing together in our business moving forward, helping other people heal*."

Building direct relationships with customers through farm stores and farmers markets, customer appreciation towards the quality of their products, and feeding the community local, place-based, and healthy food was a social value portrayed by many of these farmers.

A majority of farmers in the study depicted ecological values towards the ecosystem, environmental sustainability, and animal welfare that guided them towards engaging in eco-entrepreneurial behaviors. These farmers displayed a connection with animals and were highly motivated by animals' happiness and wellbeing. These farmers also engaged in regenerative practices and changed their management practices and operations to include agroforestry and silvopasture on their farms for improved ecosystem benefits. One such beef farmer (P2) expressed,

"*I'm thinking about production and numbers more and more because you really do have to, but I think that's not... I feel like that's like a requirement, not where my heart is, right? So, the work that I do is mostly centered around land regeneration*."

On the same note, another farmer (P5) expressed her role as a land steward,

"*I would say that my most important and longest-term goal as a farmer is to improve the land that I'm on. And by improving the land, I actually mean improving the micro ecosystem that I improved the water holding capacity and that I increased the biodiversity here and that we grow more different kinds of perennial foods. So, whether that's from grass or that's other kinds of perennial foods, then we have a healthier ecosystem when I leave. So, I think of it not just as being a farmer but as a land steward. And I think that more and more as I go along, and what are the ways that I can be the best land steward that I can be*."

Some farmers also centered their farming activities to enhance animal welfare and were motivated to engage in eco-entrepreneurial activities by seeing animals grazing out on their lands and in least stressful conditions. A beef farmer (P15) expressed how he was very concerned raising beef in no-stress environments and how he hopes to structure his business model to align with his values while catering to additional markets,

"*To me, the brand is Beef Better, and it's really just saying, these animals have no stress, these animals are living in one place. These animals live their entire lives without being pressed, without being crowded, without being trapped, without being thrown into a feedlot and the extreme stress*."

Other prominent values that emerged through the conversations with farmers were expressive and intrinsic values that highlighted their sense of identity as a farmer. These values displayed how farmers engaged in creative pursuits and entrepreneurial behaviors guided by their identity as farmers. They expressed how farming was part of their lifestyle, enjoyment, and spirituality. A small-scale sheep farmer (P7), who

also extends extension services to other farmers expressed how his identity in farming motivates him,

"*Farming is my lifestyle and my identity. It is hard to stop now*."

A medium-scale beef farmer (P10) expressed how he enjoys farming and also enjoys the products that he makes which he caters to high-end restaurants in Boston, saying,

"*It's definitely a business and also a benefit to my quality of life. It's a business that I enjoy for the most part, the work and what it does to my local environment, to how it enriches my home and my body. I'm pretty selfish, so the products that I make, I like to enjoy. So thankfully, my chef doesn't take everything. Eating my products keeps me motivated*."

In contrast to these values, farmers also highlighted instrumental values as is typically observed among entrepreneurs. However, these values emerged less frequently compared to the other values expressed by farmers as described above. Instrumental values emerged through farmers' orientation towards attaining high profits and improved product quality to gain higher economic value. Although profit-seeking intentions were less frequently highlighted by farmers, they expressed how seeking economic values or profits enabled them to remain resilient and economically viable in order to perform their best as land stewards or build community around them. A sheep farmer (P5) who had diversified operations and income streams, expressed how important profits were to sustain a viable operation, and how it should not be a reflection of herself as capitalistic or greedy, but rather a need to remain resilient,

"*So often, we act and speak and feel in agriculture like profitability is a dirty word and money is a dirty word and we don't want that because we want the lifestyle. The lifestyle is enough and going out on the land is enough. I am just going to say, I don't*

know if anybody else is going to say this, but it's not enough. We actually need money so that we can do a good job on our land, so that we can have healthy businesses, so that we can fix our broken houses and our broken cars and trucks and we can take our families on vacations and do the things and invest in things that are not on the farm so that we are not tying our entire future to whether or not we have any social security left or we don't because we never drew a salary. There's so much poverty built into farming culture that I want us to talk about financial profit as an important thing, and not just the ecosystem stuff. Because I love the ecosystem stuff, and that is what keeps me going, but what I've come to realize is that the farm, the financial profit side of it, if we don't have that, we are fooling ourselves."

As discussed through existing literature, entrepreneurial behaviors of farmers were guided by a myriad of attitudes towards such behaviors. These farmers too, displayed risk-taking, innovative, and opportunistic attitudes typically exhibited by entrepreneurs who are driven by a willingness to change, attain higher values, and enhance resource-use efficiencies (Cantillon, 1755; Schumpeter, 1934; McElwee, 2008; Dias et al., 2019). Resiliency-focused attitudes of farmers exhibited through this study resonate with prior literature that argue that diversification helps firms remain resilient and sustainable (Gray, 2002; Niska et al., 2012). However, while many researchers argue that entrepreneurs are usually motivated by 'pull' factors such as the presence of resources, innovation, risk-taking, and high opportunities (McElwee, 2008; Wale and Chipfupa, 2021), farmers in this study were seen to be motivated towards entrepreneurial activities such as diversification through 'push' factors as well. These farmers were pushed into diversifying through a lack of resources in their core farming enterprise and considered diversifying as a strategy to remain resilient. Such behaviors and attitudes deviate from the commonly conceived attributes of

typical entrepreneurs as being profit-motivated, extractive, and capitalistic (Pemadasa, 1994), and sheds light into how entrepreneurs may emerge from resource constrained and subsistence-based operating contexts as an adaptation mechanism to remain viable and resilient (Wale and Chipfupa, 2021). Such farmers exhibited resource-dependent and low growth-minded attitudes, and elicited how such attitudes motivated them to engage in pluri-activity and eco-entrepreneurship. Wale and Chipfupa (2021) attributes these behaviors to the operating contexts of different producers, indicating that depending on the operating environment whether it may be deterring or enabling, entrepreneurs may operate economically, resource-dependently, opportunity-based, or even subsistence-based.

Many studies indicate how farmers' values and identities may affect their entrepreneurial intentions and behaviors as examined through this study as well. Although Davis-Brown & Salamon (1987) discussed how entrepreneurial farmers emphasized on the individuality over the relational aspects of farming, the farmers in this study exhibited many relational values rooted within community, family, tradition, and ecosystems. These findings agree with Dudley's (2003) studies where they discuss that entrepreneurship exists in community settings and that communities may even be bound by an entrepreneurial spirit. Agreeing with Niska et al. (2012) and Fitz-Koch et al. (2018), this study also reflects how entrepreneurial farmers while having instrumental values, did also exhibit strong expressive and intrinsic values, although they engaged in other operations as pluri-active farmers. As per De Bernardi & Pedrini (2020), identities of farmers were an important aspect that influenced their personal behaviors where these farmers too were motivated to act in a manner consistent with their identities.

Perceived Social Norms

According to the TPB, subjective norms or individuals perceived social norms such as perceived social pressures may influence them to perform or not perform a behavior (Ajzen, 1991). Farmers in this study, too, displayed various social pressures and perceived social norms that motivated them to exhibit entrepreneurial behaviors, aligning with literature on the TPB (Ajzen, 1991). These perceived social norms mainly emerged as motivations from other farmers who were engaging in entrepreneurial activities, motivations from customers and community, and social pressures towards engaging in entrepreneurial behaviors.

Many farmers expressed how their activities were influenced by what other farmers in their community and network were doing. These farmers were inspired by other farmers and followed others and at times implemented new practices, technologies, methods, infrastructure, and other innovations following the other farmers. A beef farmer (P2) expressed,

"*I don't follow other farmers unless it is inspirational. If you do something really cool and I'm really interested in what you're doing, I'm seeing you have better production or something positive with your animals, or like I was saying with Kevin, I don't do tillage really except for these one-time things that we're doing right now, but I'm still fascinated by how he grows and the way that he grows and what he does. So those things can be definitely influencing*."

Some had frequent meetups with farmers online and on-farms and discussed ideas and strategies and networked within professional organizations and farmer organizations. Such behaviors can be considered highly entrepreneurial where farmers exhibited cooperating and networking skills, while being motivated by others to engage in entrepreneurial activities (McElwee, 2008). Although this is contradictory to studies

that indicate entrepreneurs tend to operate individually and display less relational aspects such as cooperation and working with community (Davis-Brown & Salamon, 1987), these farmers also displayed guarded attitudes where they restrained from divulging business models, strategies, or innovative mechanisms unique to their individual farms, in order to retain their identity and standing in a competitive market environment. A beef farmer (P3) explained,

"*I lift ideas from other places all the time. Like, I've got my local guys, we all went through ranching for profit stuff and so we have this connection, and we share ideas, we trade cattle back and forth and it's an ongoing thing. And then there's the regional which is a little further out from our friends like in Maine and then I've got this group I'm working with that is all across the US, it's like one guy in Georgia, myself, a guy in Wisconsin or Minnesota, two in Idaho, one in Texas. We try to get together every few weeks, just on a Zoom call. And because we're not in any shape or form competing with each other, we're sharing marketing ideas. So, I trust these guys, but I don't want to give them my secrets off. They don't want to give you theirs*."

Similar to the above farmer who belonged to a farmer network locally, regionally, as well as nationally, many farmers exhibited how their community or network transcends geographical and proximal communities, to include digital farmer communities as well. Many farmers formed farming communities and networks through social media and followed other well-performing farmers on Facebook, Instagram, and even TikTok, and engaged in entrepreneurial activities influenced by them. A beef farmer (P2) who engages in innovative entrepreneurial activities such as new practice and technology adoption said,

"*There's a private Facebook group with farmers all over the world. And that's really helpful, because I can ask questions, and I can get feedback. That is influential because it's inspirational and like they have experience in running a combined power herald seeder with a crazy tractor and doing a guidance system and using rock dust and 50 different species and I can't go around the corner and ask anybody about that*."

Similarly, another beef farmer who was oriented towards eco-entrepreneurial activities said,

"*You might think it's funny, but on TikTok, there's an enormous farm community, a huge regenerative ag community, which is really cool because you can just run through and glean all these ideas, save the videos, and check that out or dive deeper into that save. My wife thinks it's ridiculous, but then I show her what's there, and there's a huge community on there that is really cool*."

Unlike studies that explored influences from the family as subjective norms that influenced farmers' decision-making or practice adoption (Doran et al., 2020), in this study, family motivations or pressures appeared less and did not emerge as a main theme, although was exhibited by few farmers as motivating factors towards technology adoption behavior. Similarly, certain farmers also displayed their employees' happiness as motivating factors towards entrepreneurial behaviors, although it did not emerge as a main theme.

Farmers were generally motivated by their customers and the community, as was highlighted in the previous section on how social values influenced farmers' attitudes and entrepreneurial behaviors. These farmers aimed to become role models and serve their community through their farms, aligning with the perceptions and expectations

that the community had of the farmers in the area. Emphasizing this, a dairy farmer (P4) said,

"*A bonus to what we're doing is what people see and expect of us. My goals are to be recognized and join good programs, be successful, and be a role model*."

Another sheep and beef farmer (P14) who recently started her own farm business added,

"*When you're feeding your community, it's very tangible, it is connecting you and your community. And people come to the farm for events. And just that connection is really valuable. I definitely think that can be really energizing. And also, I think, builds appreciation for the labor. I think sometimes there is a lot of stress and uncertainty in the world in general. And I think that can also cause people to support and really value local producers, not just for food but for other things and much more. I do think in some ways, as the world becomes more chaotic, people will look more towards their home*."

Some farmers also highlighted being motivated by their customers who are not in their geographic or local community, but who are connected to the farms through their products. These farmers engaged in entrepreneurial activities to improve the quality of their products and were motivated by catering better products to their markets. A diversified beef farmer (P3) who also has pig operation, expressed,

"*When you get feedback from a customer like, hey that was the best pork chop or steak burger I have had, I'm thinking, I grew that up here, and I'm thinking wow I'm doing something right*."

Likewise, another farmer (P14) recalled her experience in receiving customer feedback and how that was extremely important for her and motivated her in her farming activities,

"*I remember distinctly last year, there was a time when it was like 9pm and I was getting water for cows at my parents, in the dark. And I looked at my phone, and I had just gotten an email from a customer who had just bought a half beef. And he was emailing to let me know how much his family loved the beef. So, things like that definitely keep me going*."

In contrast to farmers who experienced 'pull' motivating factors, some of them also experienced social pressures as 'push' factors that made them engage in entrepreneurial behaviors. According to McElwee (2008), such traits might not be typical of an entrepreneur, and might even distinguish highly entrepreneurial farmers from less entrepreneurial ones. However, these farmers also engaged in entrepreneurial activities such as eco-entrepreneurship and value-added production, although they faced social pressures that motivated them to alter their management practices and certain unsustainable farm operations. A dairy farmer (P6) who recently transitioned to a custom grazing operation expressed how he was affected by social pressures,

"*Your pride and your face are at risk if you lose or don't achieve*."

However, some farmers also displayed independent attitudes that did not conform to social norms or pressures, indicating that they did not care much for what others did or expected of them, and wanted to carry out operations aligning with their own farming values and personal goals. One such beef farmer (P15) said,

"*I feel very strongly about the kind of farming that I want to do and the kind of beef production I want to do. I am very conscious of not doing it in a way that seems like a criticism of how other people do it. But as far as trying to fit into what other people are doing, not very much, I'm not trying to fit into the industry*."

These findings appear largely contradictory to expectations under the TPB (Ajzen, 1991), and suggest Vermont livestock farmers might engage in entrepreneurial behaviors that do not conform with society standards or expectations, and other subjective norms. However, this may be explained through farmers' perceived behavioral control and self-efficacy, and strong values they have within themselves to carry out a farming operation aligning with their goals that may not always be influenced by their perceived social norms.

Perceived Behavioral Control

Perceived behavioral control, as presented through the TPB, also seemed to influence farmers' entrepreneurial intentions and behaviors (Ajzen, 1991). Many farmers expressed strong perceived behavioral control, self-efficacy, and self-confidence in engaging in entrepreneurial activities. Some farmers expressed how they were good managers and were confident in carrying out efficient operations by adopting new technologies and establishing good infrastructure. A dairy farmer (P4) expressed,

"*We were at the point of selling the farm or giving it a try. I was put into a very tricky position, but it worked out. Our infrastructure is in a great place and our management is really good. Having a plan B is also important. Good management makes a big difference. We try to farm with intent and do it with intent every day, by building instinct and good common sense*."

Although many farmers appreciated working with community, some farmers also expressed how operating individually works for them and reflected their perceived behavioral control in that they could carry out activities by themselves, with less help from the community. One such diversified co-species grazing farmer (P9) expressed,

"*I very much consider myself an entrepreneurial farmer. I tend to work in isolation, I think the problem is you're your own person. There is so much herd mentality nowadays. I think it is nice to have community, but you need to do it alone.*"

Farmers also expressed how their perceived behavioral control helps them navigate various market and environmental challenges they face. These farmers seemed to have strategies in their mind for how they will change their management or alter their business models for in instances they face constraints or challenges that threaten the resilience of their business operations. A beef farmer (P10) said,

"*Everybody loves beef, always, so it's like kind of always a commodity that I can sell, even if it's at a loss, it can cut my costs and I can still recoup a lot of my expenses. Like if I absolutely had to, in a really bad drought scenario, I could cut the herd in half, rent freezer space and just slaughter a ton of cows. And let my employees go and work the place myself like I did for six years*."

Although such strong perceived behavioral control was exhibited by many farmers in this study, some farmers also indicated lack of confidence, motivation, and even regret in engaging in certain entrepreneurial activities. Such feelings made these farmers change their management practices and business models. As TPB suggests (Ajzen, 1991), farmers who experienced a lack of perceived behavioral control did not engage in highly entrepreneurial behaviors such as diversification, technology adoption, or even innovations. These feelings and attitudes were also seen to be

influenced by environmental and market-related challenges, and resource constraints that inhibited their entrepreneurial activity. A farmer who strongly experienced these feelings expressed how farming now has become a process of grief for him, and how he felt like he wasted many years doing things he did not enjoy or was enthusiastic about. This farmer who used to produce his own dairy, recently changed his business by selling his dairy herd to currently have a custom grazing operation on his land. He (P6) expressed,

"*I sometimes don't know what I'm doing, it's really humbling. I am doing commodity farming, but it is not going to be sustainable. Diversification process needs nuance and I have a hard time with subtlety and nuance. There were seasons where I felt very entrepreneurial. But I don't feel very entrepreneurial right now. But on the other hand, there are risks associated with being comfortable. In theory, I'm young and have resources to move in a different direction, but I spent too much time treading water and dabbling*."

The TPB components examined through the interviews and how they are related with different types of entrepreneurial behaviors exhibited by farmers is summarized in Figure 3.

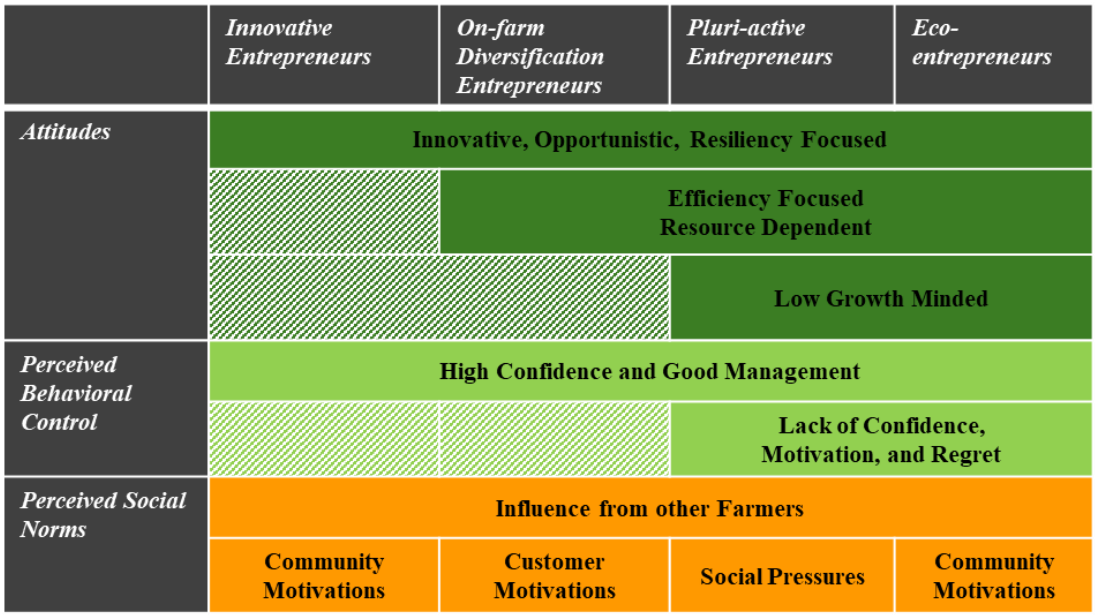


Fig. 3. Summary of Relationship Between TPB Components and Entrepreneurial Behaviors

Quantitative Findings

In this section, we present descriptive results and bivariate analyses of TPB components related to entrepreneurial behavior, and their associations with farm and demographic characteristics.

Descriptive Analysis

Based on the results of the qualitative study, we categorized the survey responses in to the four themes of entrepreneurial behaviors that emerged: on-farm diversification entrepreneurs, innovative entrepreneurs, eco-entrepreneurs, and pluri-active entrepreneurs. We identified the categorization criteria of these respondents based on the sub-themes of the entrepreneurial behaviors that emerged from the qualitative data. We categorized respondents as on-farm diversification entrepreneurs ($n = 9$), based on if they engaged in any diversified activities on the farm, by producing more than one product, having value-added operations, and catering to multiple markets

such as farmers markets, CSAs, and online markets. Innovative entrepreneurs (n = 10) in the sample were recognized and classified based on the technologies they adopted such as computerized decision support tools and their strong attitudes towards innovation and experimentation. We identified eco-entrepreneurs (n = 10) as those who practiced regenerative management practices such as rotational grazing and adopted environmentally friendly certification schemes such as organic, non-GMO, animal welfare, grass-fed, and rotational grazing. We identified pluri-active entrepreneurs (n = 4) as those who had off-farm income streams as well. Farmers who depicted pluri-activity indicated engaging in off-farm activities as farm audit contractors, musical instrument businesses, farm financial consultants, and timber producers. Similar to the qualitative study, these categories were not mutually exclusive, and producers even existed in more than one category of entrepreneurial behavior. Among the respondents, two producers engaged in value-added dairy operations, and six used computerized decision support tools. Figure 4 displays the distribution of respondents under the different classifications of entrepreneurial behaviors.

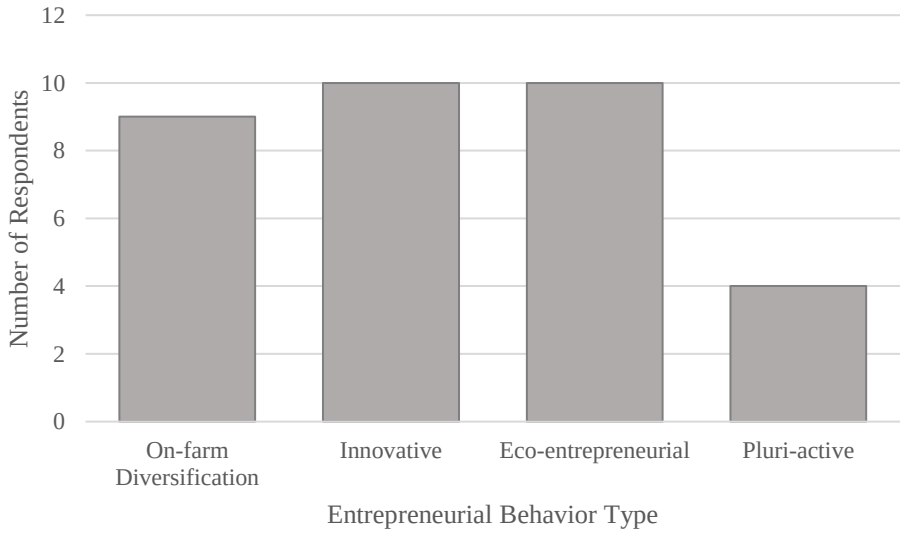


Fig. 4. Distribution of Types of Entrepreneurial Behaviors

In the survey, we inquired into the farm's perceived economic viability at present, and in the next 5 to 10 years, so we present these findings separately for the four categories of entrepreneurial behaviors. A majority of on-farm diversifying entrepreneurs indicated that their current operations were economically sustainable, but there were few that indicated their current operations were economically vulnerable without any built-up equity. However, these farmers expected a change in farm viability over the next 5 to 10 years, where some farmers expect to reach economic viability by having the capacity to cover all costs, pay labor at the average agricultural wage, and generate a profit, while those who experienced vulnerable situations expected to be economically sustainable businesses. Likewise, eco-entrepreneurial farmers too displayed viable, sustainable, and vulnerable businesses at present, but expected to reach economic viability or sustainability in the future. All innovative entrepreneurial farmers responded that they have economically sustainable operations at present, but in the future, some of them expected their operations to reach economic viability by generating profits. Pluri-active entrepreneurs too displayed a similar scenario by displaying economic sustainability at present but expecting to reach viability or remain sustainable in the future as well. These findings are displayed in Figure 5.

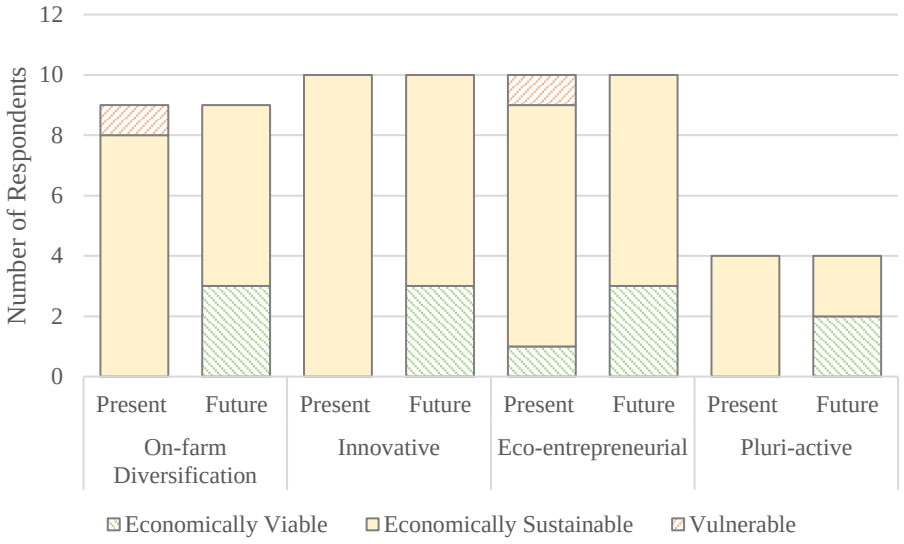


Fig. 5. Current and Future Farm Viability Based on Types of Entrepreneurial Behaviors

The survey inquired into the drivers of decision-making for these producers, and these results are displayed in Figure 6, classified under various entrepreneurial categories. On-farm diversification and innovatively entrepreneurial farmers displayed main drivers in decision-making as animal health and welfare, while some farmers said financial costs and benefits were the main drivers, with very few responding that environmental impacts were a main driver. Eco-entrepreneurial producers responded similarly, with many indicating animal health and welfare as the primary driver, followed by financial costs and benefits and environmental impacts. One eco-entrepreneurial farmer indicated that their primary driver in decision making was

family heritage and traditions. However, for all pluri-active farmers, their main driver for decision-making was animal health and welfare.

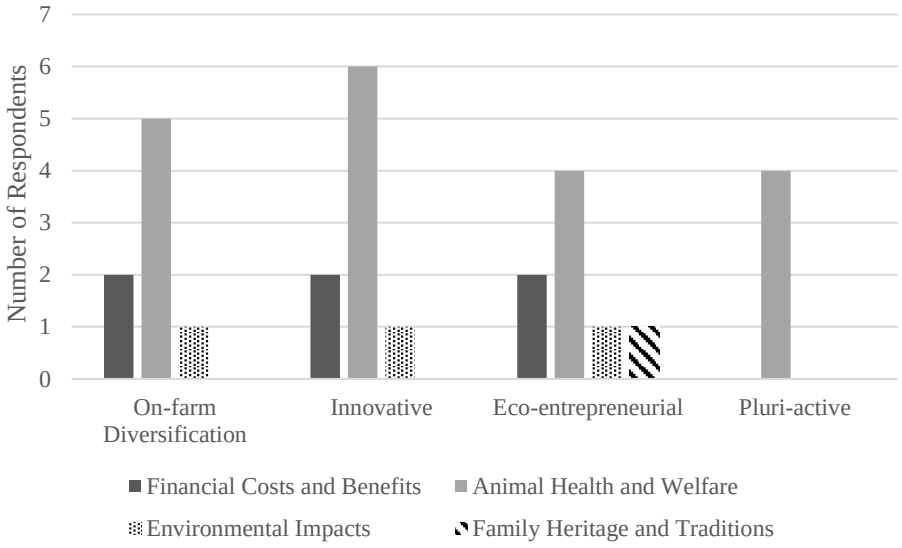


Fig. 6. Drivers for Decision-making for Different Entrepreneurial Behaviors

Bivariate Statistics

Since we operationalized the TPB constructs using scale measures consisting of multiple items, we generated additive scales for each construct: entrepreneurial behavior, entrepreneurial intention, attitudes, perceived behavioral control, and perceived social norms, on Stata 17.0 software. To identify associations between the scale variables, we treated the additive scales as continuous data and conducted Pearson's correlation tests as bivariate tests (Sullivan & Artino, 2013). We dropped missing data from the analysis, and it resulted in 16 observations to be included in the final correlation test.

The Pearson's correlation test shows a significant positive correlation between entrepreneurial attitudes and perceived behavioral control ($\rho = 0.48$; $p < 0.10$), and a significant positive correlation between perceived social norms and entrepreneurial behaviors ($\rho = 0.45$; $p < 0.10$). However, the test did not depict any significant

association among the other TPB constructs. Although a causal relationship is not pursued through this test, the association between perceived social norms and entrepreneurial behaviors align with the TPB (Ajzen, 1991). Furthermore, although attitudes, subjective norms, and perceived behavioral control are independent predictors of intention conceptually, empirically they may correlate with each other with low to moderate correlations among them (Ajzen, 2020). This is exhibited in this study through the correlation between entrepreneurial attitudes and perceived behavioral control. The results of the Pearson's correlation test are displayed as a matrix in Table 5.

Table 5
Pearson's Correlation Matrix for TPB Constructs

	Entrepreneurial Behavior	Entrepreneurial Intention	Attitudes	Perceived Behavioral Control	Perceived Social Norms
Entrepreneurial Behavior	1.0000				
Entrepreneurial Intention	0.1101	1.0000			
Attitudes	-0.1777	0.3753	1.0000		
Perceived Behavioral Control	0.1256	-0.0727	0.4815*	1.0000	
Perceived Social Norms	0.4500*	-0.1103	0.1232	0.3640	1.0000

*p value < 0.10.

We conducted simple bivariate tests using Pearson's correlation, Spearman correlation, and One-way ANOVA to investigate the associations of demographic characteristics, farm characteristics, and environmental and market challenges with the entrepreneurial behavior of producers. Pearson's correlation shows a significant positive correlation between land size and entrepreneurial behavior of farmers (ρ = 0.72; $p < 0.05$), aligning with prior literature that discuss how farm size and scale may affect entrepreneurial activities such as technology adoption and diversification

(Khanal et al., 2010; Pruitt et al., 2012). In turn, the higher the entrepreneurial activity, these operations may expand or may need to expand in order to diversify, adopt technologies, or build more infrastructure on their land, needing them to obtain more land or increase in scale. Data, however, do not reveal any other associations of demographic or farm characteristics, or market and environmental challenges with the entrepreneurial behavior of farmers.

Overall Discussion

Defining and distinguishing entrepreneurial behavior in farming has always been challenging and complex. However, prior literature attempts to define entrepreneurs in farming as those who innovate, diversify, network, adopt new technologies and practices, strategically orient to new markets, engage in value-added production, agritourism, and more (Schumpeter, 1934; Carter, 1998; Eikeland and Lie, 1999; McElwee, 2006; Pindado & Sánchez, 2017; Dias et al., 2019). Furthermore, entrepreneurial behaviors also differ based on the type of operation, for example, depending on if they are cattle operations such as dairy and beef, or small ruminant operations such as goat and sheep. While dairy and goat farmers may increasingly look towards value-added production and adopting milking, grazing, and management technologies, beef and sheep farmers may look for diversified marketing avenues by raising grass-fed animals and managing all-natural and organic farms to attain higher value from their operations (Morris et al., 2017; Hart et al., 2019; Micheels at al., 2019). Similar to these studies, farmers who participated in this study through interviews and the online survey demonstrated entrepreneurial behaviors in a variety of ways. These behaviors were categorized broadly as on-farm diversification (Carter, 1998; Eikeland & Lie, 1999; McElwee, 2008; Niska et al., 2012), innovative

entrepreneurial behavior (McElwee, 2008; Dias et al., 2019), eco-entrepreneurial behavior (Indaco-Patters et al., 2013; Mieszajkina, 2016; De Bernardi & Pedrini, 2020; Giller et al., 2021), and pluri-activity (Vesala and Peura, 2003; McElwee, 2008; McElwee, 2010).

A majority of farmers across both samples demonstrated engaging in on-farm diversification, innovative entrepreneurial behavior, and eco-entrepreneurial behavior, with only a few farmers engaging in pluri-activity. Although on-farm diversification and innovative behavior are commonly emphasized as entrepreneurial behaviors where farmers are 'pulled' to engage in (McElwee, 2008), Vesala and Peura (2003) argue that pluri-active entrepreneurs who engage in off-farm income streams display a 'forced entrepreneurship', owing to a lack of inner motivation towards entrepreneurship from the farmer's side. The farmers in this study displaying strong identities as farmers and land stewards embedded within tradition and family farming, may explain why they displayed less tendencies towards pluri-activity.

The findings of this study highlight various motivations and attitudes that farmers have towards engaging in entrepreneurial activities. Many studies show that farmers engage in entrepreneurial activities as a way to remain resilient and sustain a viable operation (Anand Singh & Krishna, 1994; Gray, 2002). This holds true for many farmers in this study who were motivated to engage in entrepreneurial activities as a means to enhance their resilience. The quantitative findings display how farmers viewed their current resiliency and economic viability. While many farmers considered themselves economically sustainable, there were few who were economically viable by generating a profit and those who considered themselves economically vulnerable as well. However, all farmers anticipated a positive change

in their resiliency towards reaching economic sustainability or economic viability in the future.

While resilience and economic viability were main motivating factors for farmers to engage in entrepreneurial activities, they were motivated by other factors as well. Some displayed clear opportunistic, innovative, and risk-taking attitudes with a willingness to change and explore new opportunities as is typical for a growth-motivated entrepreneur dispaying 'pull' attributes (Cantillon, 1755; Schumpeter, 1934; McElwee, 2008; Dias et al., 2019). Contrastingly, some displayed low-growth minded attitudes, with an aversion to adopt new technologies, take risks, or to diversify their businesses. These farmers, however, displayed changing their management practices towards low-input production, and sustainable and regenerative management by exhibiting eco-entrepreneurial behaviors.

Various attitudes that farmers had towards engaging in entrepreneurial activities were influenced by their values and identities. While some studies indicate entrepreneurs as capitalistic, extractive, individualistic, and self-interested (Davis-Brown and Salamon, 1987; Pemadasa, 1994), entrepreneurial farmers in this study exhibited other values that guided their motivations towards entrepreneurship. While making money was seen as necessary for them to survive, they behaved in a way motivated by family, community, concern for the environment and animals, aligning with their identities as land stewards rather than business operators (Dudley, 2003; Niska et al., 2012; Fitz-Koch et al., 2018). These values were highlighted in the quantitative strand as well, in which farmers expressed that animal health and welfare, and ecological impacts were main drivers towards decision-making for their farms. While qualitative findings suggest that various attitudes towards entrepreneurship influence the kinds of entrepreneurial behaviors that farmers engage in and their entrepreneurial intentions,

the quantitative study did not find any statistically significant association between farmers' attitudes and intentions or entrepreneurial behavior.

The qualitative component shows how farmers' entrepreneurial activities were influenced by other farmers in their geographic and digital networks, as well as their customers and community. The quantitative study, too, displays an association between farmers' subjective norms and entrepreneurial behavior, where farmers' entrepreneurial activities were seen to be associated with their perceptions of community norms around entrepreneurship and other farmers' behaviors. These findings agree with the TPB (Ajzen, 1991) which presents that perceived social norms may influence an individual's behavior. Entrepreneurial attitudes and perceived behavioral control were seen to be positively associated with each other (Ajzen, 2020), indicating that farmers who had favorable attitudes towards engaging in entrepreneurial activities may have had stronger confidence in their ability to engage in entrepreneurial activities, or vice versa.

Statistical analyses, while suggesting a positive correlation between land size and entrepreneurial behavior (Khanal et al., 2010; Pruitt et al., 2012), did not depict any association of other demographic, farm characteristics, or environmental and market challenges with the entrepreneurial behavior. Although the TPB (Ajzen, 1991) explains how perceived behavioral control is an antecedent to an individual's intention to perform a behavior and the actual behavioral activity, statistical analyses in the study do not show any significant association between these constructs. However, the qualitative findings of this study elicit that various challenges and resource constraints that farmers face may be associated with their perceived behavioral control, affecting their capacity and perceived ability to engage in entrepreneurial activities or even intend to be more entrepreneurial in the future.

Challenges

Many farmers reported personal wellbeing as a main challenge and risk, limiting their activities. Risks to personal wellbeing are experienced by farmers in the form of burnout, risks to health, diseases, and injury, heavy workload and hard work, having no time off, stress, retirement concerns, and lack of proper insurance. Farmers expressed the challenges in managing multiple operations such as in diversified farms, where they may not be compensated fairly for their labor. Some farmers reported already experiencing burnout and therefore they tend to manage their operations under less stress and risky conditions without further experimentation or exploration. Risks to health and injury due to working with animals and machinery was evident among farmers managing these livestock farms. In addition, proper healthcare is greatly lacking due to the inaccessibility and lack of proper insurance for farmers or businesses, as farm work, especially small, medium scale, or homesteads may not be classified as jobs that may be qualified for affordable insurance. As explained by a farmer (P3), "*You can't buy insurance as a business until you have a threshold of five full-time equivalent employees, that all want to sign on to the health insurance. So, because I looked into it since I can buy health insurance through the business for me so it's pre-tax. Nope, not allowed. So, I have to go post-tax and it's 900 bucks a month*".

Financial constraints, in the form of debt, cost of equipment and machinery, financial risks, and the perceived financial losses associated with certain farm activities were other challenges that were inhibiting some farmers to engage in certain entrepreneurial activities. Since these farmers' biggest goals were to get out of debt, they were unlikely to engage in entrepreneurial activities such as diversification or

innovative behavior. They took small financial risks and hoped to sustain the operations, at certain times changing their management practices to stay resilient.

Concerns related to labor were a main challenge expressed by farmers. While many of these farms functioned with family labor, some also had hired labor from the community. Many of them expressed dissatisfaction with the lack of proper compensation for their labor when they are managing their own operation. Many farmers did not pay themselves a livable wage or even attributed a value to their labor to compensate themselves for their time and opportunity cost. Many expressed how lack of pay was affecting their personal wellbeing and was also restricting them to engage in other activities or devote more time to experiment or expand their operations. Farmers expressed how housing was a big issue for the employees hired on their farms. Especially farms that operated with a community-centered model were unhappy with the lack of housing and the unaffordability of housing for employees. Therefore, some farmers have already initiated developing housing for the employees working on farms, to retain labor for the farms as well as to foster a farming community around themselves. While lack of labor was an issue for some farmers, the lack of service providers in the community for maintenance and repair of machinery and equipment too challenged farm activities.

Environmental challenges and climate change were a big concern for farmers that motivated them to engage in eco-entrepreneurial activities as an adaptation mechanism. Extreme weather events such as flooding and droughts have affected most of these farms over the years, and many are impacted by soil health concerns. Farmers experience soil compaction, lack of pasture diversity, productivity, and quality, and have changed certain management practices to improve pasture quality, soil health, and biodiversity in their lands. For many farms, intensive grazing

management practices serve as a practice to stay resilient to climate change and environmental challenges.

Farmers experience many market-related challenges that they struggle with in operating their farms. Dairy farms receiving a lower price for milk and changing consumer demands where people consume less raw milk have made these farms diversify and engage in value-added production. Farmers face high input costs for fuel, hay, and nutrients that affect their grazing management practices and supplemental practices such as seeding and adding nutrient amendments. Market instability and the instability of cooperatives where most dairy farmers sell milk have made farmers more concerned about their market streams and security. Cooperatives not being committed to buying milk and being able to drop farms at any time has made farmers more concerned about their future and viability. For beef farmers, various industry regulations around slaughtering and processing meat restrict their activities and have made them unable to carry out their operations aligning with their farming values. According to a beef farmer (P15) who does custom slaughtering, industry standards would make his cattle undergo stressful conditions, he said, "*Because you've got to follow them all through these basic pinch points that stress them. And one of those basic pinch points is it only makes sense if I run 20 animals to the floor house, get them in the trailer, ride them through the trailer, get them to a strange feedlot where they're smelling feet, and they smell fear for the last two days of their lives to be fed something they may or may not have ever eaten. That's a stressed animal. And you can grass-feed them all you want up until that point. That's a stressed animal, man. And to me, that's unacceptable, personally*."

While the farm future and farm succession were concerns for many farmers, they engaged in entrepreneurial activities hoping that the future generation would receive a

viable and self-functioning farm that generates a profit. Although some of these farmers did not have any children yet, they expressed similar sentiments in hoping to pass on the farm for the future generations. For all farms in the study, farm labor was provided mainly by the family, with very few farms having additional employees as farm workers who work on the farm full time or part time. These farm workers were people in their locality, and none of the farmers in this study had migrant labor employed on their farms. This may be due to the small and medium size and scale of these farms that make it functional with few employees and the family. However, with the increasing trend towards farm consolidation in the dairy sector, the migrant labor population is increasing where a lot of the milk production is facilitated by migrant workers (Mares, 2019). In the current Vermont beef sector, where small scale grazing beef farms are emerging, it is important to investigate how the sector may be changed with the increasing migrant worker population. Although migrant labor is not employed by farms in this study, further research around migrant labor and if they are employed by other small and medium scale livestock farms in Vermont may be beneficial to investigate to identify how migrant labor would shape farm succession, viability, and financial stability of these farms.

Cultural problems and conflicts were also expressed as a concern for some farmers, where some neighbors would question certain farm activities such as manure application or clearing fields for grazing management. Farmers attributed these conflicts to a lack of awareness among some community members about farm activities and management practices, and the ecosystem services resulted by their sustainable management practices.

The quantitative findings, too, showed many concerns and challenges for farmers, as represented in Figure 7. The figure depicts the concerns for each challenge on a

Likert-scale, averaged across the respondents. According to this figure, farmers on average were most concerned about climate change, cost of equipment, and the loss of family farms, while being least concerned about community and neighborhood dynamics and external institutions such as cooperatives. However, it should be noted that this figure reflects concerns of farmers averaged across the sample and does not reflect individual concerns or challenges in a context-specific manner as described in the qualitative study.

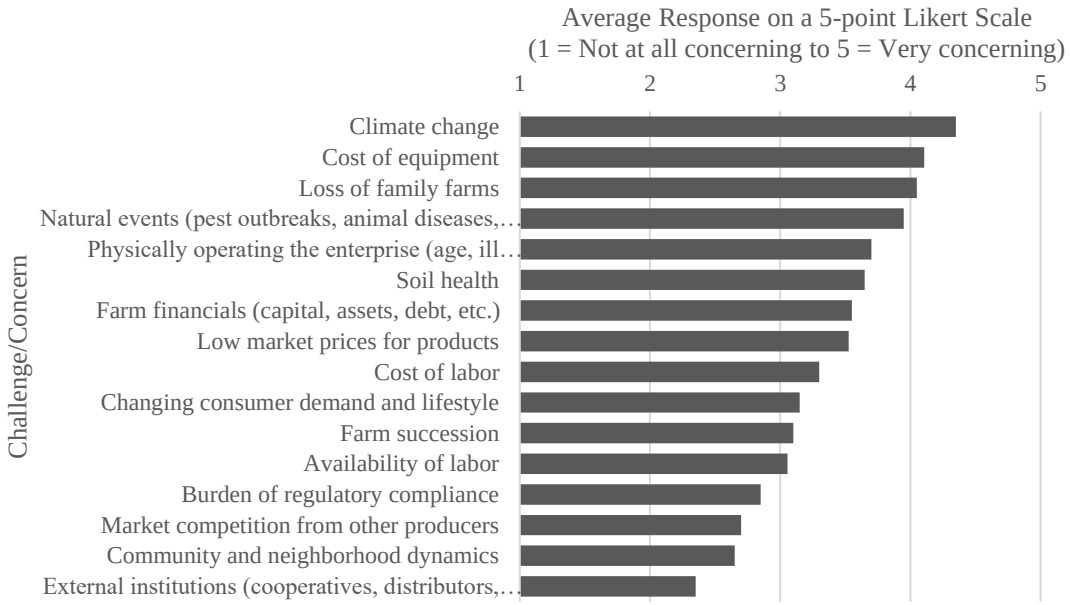


Fig. 7. Challenges and Concerns Experienced by Surveyed Farmers

While farmers face such numerous challenges, they explained how various mechanisms and programs have made them resilient to risks and challenges, making them adapt and mitigate impacts of these challenges. Many farmers mentioned how participating in grants has made them stay resilient, where they would get financial support to adopt technologies or new practices or build new infrastructure to engage in entrepreneurial activities. However, most farmers do not enjoy that they have to

participate in a grant in order to farm, which they consider an additional activity that does not align with their identity as a farmer or what a farmer is supposed to do.

Farmers also engage and seek educational opportunities such as classes, diplomas, and business courses to gather new information and improve their operations. Engaging in business consultations, extension services, working with non-profits, and participating in farmer associations and organizations where their voices are heard, were expressed as valuable opportunities for farmers to remain resilient. From a policy side, farmers mentioned receiving tax incentives and better healthcare and insurance programs would make them farm more successfully and happily. While numerous opportunities for enhancing resilience were external, some farmers also mentioned how they remained resilient through personal activities and self-care. Engaging in meditation, spiritual activities, and taking the time to engage in artistic activities and relaxation were expressed as ways that help some farmers stay resilient to the challenges they face.

Conclusions

In a volatile operating environment with increasing climate and market related challenges, farmers display the need to engage in entrepreneurial activities to remain resilient. However, irrespective of many studies that indicate farmers are pulled to engage in entrepreneurial activities through internal motivations (McElwee, 2008), entrepreneurship also emerges out of necessity in resource constrained environments as an option to stay resilient. Not all farmers display the need to engage in expansive entrepreneurial operations such as diversification or technology adoption or innovations. But all farmers display entrepreneurialism in some way, either seeking new markets, new products, or even changing their management practices to adapt to climate and environmental challenges. Therefore, promoting diversification as a

standard strategy that all farmers need to achieve may not help many farmers to maintain a viable operation, aligning with their goals. Entrepreneurship needs to be supported, knowing in which ways farmers intend to be entrepreneurial. For example, supporting farmers to change their management practices towards eco-entrepreneurship, or extending information and resources to adopt technologies or engage in innovative behaviors may facilitate farmers to sustain a viable operation for the future.

Many factors seem to influence farmers' entrepreneurial behaviors, including their attitudes towards entrepreneurship, and perceived social norms of societal perceptions towards entrepreneurial activities. Farmers tend to learn a lot from other peers and adopt practices and technologies that other farmers have tested and experimented with. Facilitating farmers to build community or engage in farmer organizations and peer-learning may be resourceful for farmers to engage in entrepreneurial activities more confidently. Evidently, farmers' motivations are not entirely instrumental or profit motivated. While profitability is a necessity to sustain a viable operation, farmers' core motivations are seen to be guided by family, community, customer appreciation, environment, and animal health. Therefore, when presenting strategies to enhance resilience in farms, it needs to recognize farmers' values and present strategies that align with these values. For example, introducing a technology that is resource extractive and unsustainable on the land may not be adopted by many due to farmers' concern about environmental sustainability.

Although farmers intend to engage in entrepreneurial activities in various ways, their perceived ability to engage in such activities confidently is influenced by numerous challenges and resource constraints they are faced with. Lack of proper healthcare and insurance, poor wellbeing and risks to health, poor pay for labor, lack of housing for

employees, market instability, climate change, debt concerns, cost of equipment, and farm succession are main challenges that affect farmers' confidence and restrict them from engaging in certain entrepreneurial activities. Therefore, policies devised to extend affordable healthcare and insurance, housing, stable markets, and greater access to finance, resources, and information may in fact help farmers to remain resilient and engage in viable operations, more happily.

This study has several limitations that affect the validity and reliability of the presented findings. The quantitative section of the study is very limited in terms of the small sample size, and therefore lack of generalizability. Rigorous statistical analyses are not presented in this study due to the small sample size of survey respondents. However, supplementing the study with qualitative data may have contextualized the discussions around entrepreneurial behavior more descriptively. It would be valuable in the future to disseminate the survey to more farmers and at the proper time when farmers are not engaged much in field activities. It would also be useful to have follow-up interviews with farmers who participated in the survey to contextualize survey results. For future research, it would be valuable to replicate this study in other states in the Northeastern US and also for more agricultural enterprises beyond the livestock sector.

CHAPTER 3: TECHNOLOGY ADOPTION BEHAVIOR OF SMALL AND MEDIUM-SCALE MAPLE PRODUCERS IN VERMONT

Introduction

The United States is the second largest maple syrup producer across the world, accounting to a production of approximately 5.03 million gallons of maple syrup (USDA, 2022). Vermont, as the top maple producing state in the US, contributes to more than half of the nation's production, amounting to approximately 2.5 million gallons of maple syrup in 2022 (USDA, 2022), which is a tremendous increase of 46% in production from the previous year (National Agricultural Statistics Service, 2022). The maple sector in Vermont, in addition to contributing to the national economy, also contributes to the image, tourism, and landscape of Vermont (Becot et al., 2015). While the natural landscape, resources, and long-lasting production seasons for freezing and thawing observed in Vermont are vital factors that facilitate a significant maple production in the state when compared to other regions (Atlantic Corporation, 2019), much of the increase in production of maple syrup in Vermont in the recent decades is brought about by the introduction and adoption of numerous technological innovations by the sector (Whitney & Upmeyer, 2004; Perkins et al., 2015; Cannella et al., 2022).

In the early and mid-20th century, traditionally, maple producers used methods such as old metal spouts, pails, and gathering tanks, led by horses, oxen or tractors for sap gathering (Thomas, 2021). These time-honored methods became obsolete with the advent of more innovative technologies for sap gathering, such as, gas and battery-powered tree tappers, light-weight affordable chainsaws, gas-powered pumps, and light-weight materials such as plastic tubing (Thomas, 2021). van den Berg et al. (2016) highlight how recent advances in equipment and practices used in maple

production have substantially increased the amount of sap extracted annually from trees. Pumps that propagate vacuum levels of ≥ 25 in. Hg through tubing collection systems, coupled with current spout technology and equipment sanitation strategies facilitate approximately double the typical yields expected from systems that use moderate levels or no vacuum and less current equipment and practices (van den Berg et al., 2016). Similar to high vacuum tubing systems, reverse osmosis technology to concentrate sap sugar content during processing, plastic tubing, and preheaters have been significant production innovations that has enhanced yield and reduced labor and processing costs (Whitney & Upmeyer, 2004; Cannella et al., 2022).

Although Vermont has experienced a boom in maple syrup production in the recent decade, producers witness various challenges in maple production, including climate-related challenges in terms of sap flow timing, variability in sap season and boil season, and fluctuations in maple syrup yield that has potential to threaten the sustainability of this flourishing sector (Legault et al., 2019; Snyder et al., 2019). Some producers perceive that adopting technologies such as tubing systems, tap hole sanitation, vacuum delivery, and novel sap processing practices would enable them to adapt to and mitigate the climate-related challenges on their maple syrup production (Legault et al., 2019; Ahmed et al., 2023). Cannella et al. (2022) highlight that with modern technologies such as vacuum tubing and taphole sanitation, it is possible to tap early to harvest the first runs with a reduced risk of premature taphole closure reducing the late season sap harvest, whereas if sap is collected using buckets or bags, the season can be considerably shorter due to drying of the taphole. However, such technologies are not equally adopted by all farms, due to concerns in preserving traditional management practices, niche marketing, and for the value of heritage (Hinrichs, 1995; Ahmed et al., 2023). Kuehn et al. (2017) identified through a mixed

methods study with maple producers from New York and Vermont, that the ability to adopt new technologies is important for maple producers to adapt to climate change. Some of the maple producers interviewed in this study indicated that they have already installed new sugaring technologies to adapt to climate change, and some are planning to do so in the future. However, the majority of them were also concerned about the financial expenses associated with adopting new technologies that influence their technology adoption behavior to some degree.

Some studies argue that technology adoption could be a climate adaptation strategy for the short-term, but for this sector to be resilient and sustainable, the knowledge of multiple adaptation strategies that focus on the long-term ecological management of forests would be more useful (Ahmed et al., 2023). The climate-adaptation strategies employed by maple producers also differ based on the scale of production, where large-scale producers are more likely to invest in expensive climate-adaptation technologies when compared to small scale producers who are interested in new technologies, but are constrained by the affordability, and their reluctance to change their already-established unique production practices (Caughron et al., 2020). Caughron et al. (2020) also show that older producers are more reluctant to adapt due to the inability to afford new technology or reluctance to change their traditional practices.

Land ownership, financial conditions, size of the land, and the cost of equipment are important criteria that affect decisions related to maple sugaring in the sector (Farrell & Stedman, 2013). Innovations in the sector such as the Brower system pipeline design were adopted by only a handful of producers, who were wealthier and progressive (Thomas, 2021). Variations in production practices and use of technologies are also influenced by race, producer heritage, producer age, size of

maple operation, and extension educational programming (Graham et al., 2021). Since producers believe that adoption of technology would help mitigate the effects of climate change, predictors of climate change perceptions, such as, political view, lack of belief in climate change, financial means, age, lack of information, lack of technical support, educational level, region, percentage of household income contributed by maple sugar business, gender, and scale of operation could also influence the adoption of technology (Legault et al., 2019).

This paper focuses on the technology adoption behavior in the maple sector and provides a context to the discussion on technology adoption as a potential adaptation strategy for perceived climate change impacts by small and medium-scale maple syrup producers in Vermont. This study investigates producers' perceptions of climate change on their maple operation, what factors are associated with the adoption of technologies in maple syrup production, and if their technology adoption behavior has any relationship with their perceptions of climate change. The results of this study would benefit future research in understanding maple producers' decision-making, their climate-change adaptation and mitigation strategies, and to develop policies that facilitate their climate adaptation behavior, and to extend more access to information and capital resources for maple producers to better navigate constraints and climate-related effects on their operations, while sustaining a resilient and viable operation.

Theory of Planned Behavior

Many studies in the disciplines of rural sociology, applied economics, psychology, and behavioral economics, and more have employed the Theory of Planned Behavior (TPB) as a guiding theoretical framework to understand farmer behaviors and behavioral intentions. In this study, we utilize the TPB to investigate the technology

adoption behavior of maple producers. The TPB extends from the theory of reasoned action and consists of the central factor of individuals' intention to perform a certain behavior (Ajzen, 1991). The TPB postulates that any volitional behavior can be predicted by three antecedents; attitudes towards behavior, perceived behavioral control, and subjective norms (Ajzen, 1991). Attitudes towards behavior is the degree to which a person has a favorable or unfavorable evaluation of the behavior, subjective norms refer to the perceived social pressure to perform or not perform the behavior, whereas, perceived behavioral control refers to the perceived ease or difficulty in performing the behavior (Ajzen, 1991). Performance of certain types of behaviors also depends on non-motivational factors such as resources and opportunities, that include, but not limited to, time, money, skills, and cooperation of others (Ajzen, 1991). We related the three antecedents in evaluating technology adoption behavior of maple producers in terms of investigating technology adoption as a potential climate adaptation strategy for maple producers.

Studies conducted in rural agricultural communities show how farmers' psychological attributes significantly influence their climate and market adaptation behaviors. A study conducted among small dairy farmers in Brazil found that attitudes, perceived social norms, and perceived behavioral control significantly influenced farmers' diversification intentions as a market adaptation strategy (Senger et al., 2017). Lynne et al. (1995) studied conservation technology adoption decisions among Florida strawberry farmers and suggested that in addition to perceived behavioral control of farmers, actual behavioral control guided by farmers' financial capabilities significantly influenced their technology adoption behaviors. A study conducted among smallholder livestock herders in Pakistan identified that attitudes were the main influential psychological factor towards climate change adaptation practice

adoption on farms, and such attitudes were mainly influenced by farmers' risk perceptions (Faisal et al., 2020). Velardi et al. (2023), qualitatively studying size and scope decisions among small and medium scale maple producers in Maine present that attitudes and perceived behavioral control guided by economic, personal, environmental, and communal factors contribute to size and scope decisions, but are less influenced by perceived social norms.

Producers' attitudes towards the adoption of technology as a climate adaptation strategy are captured by their awareness and perception of climate change and its perceived impacts on their maple operations (Li et al., 2021). Bradley et al. (2020) indicate how climate change risk perceptions directly influences personal efficacy in performing a climate change adaptation or mitigation behavior, indicating how perceived behavioral control too could be influenced by climate change risk perceptions in adopting technologies by maple producers. Some studies consider financial costs, labor costs, social, and farm characteristics as instruments that could measure the producers' perceived behavioral control (Wheeler et al., 2013). However, the TPB recognizes personality traits, intelligence, demographic characteristics, life values, and other such variables as background factors that could affect the TPB constructs (Ajzen, 2020). Additionally, maple producers' perceptions of society's evaluations of adopting technologies in maple operations can be related to the perceived social norms and pressures influencing the technology adoption behavior of maple producers.

The components of the TPB are assumed to mediate the effects of background factors on intentions and behavior. The theory recognizes the importance of background factors in providing valuable information about precursors of control, behavioral, and normative beliefs that predict attitudes, behavioral control, and perceived social norms

(Ajzen, 2020). However, in the TPB model it is possible to examine the role of background factors in influencing or not influencing behavior by tracing its effects via proximal antecedents of behavior such as attitudes, social norms, and perceived behavioral control (Ajzen, 2020). Furthermore, although attitudes, subjective norms, and perceived behavioral control are independent predictors of intention conceptually, empirically they may correlate with each other with low to moderate correlations among them (Ajzen, 2020). The author highlights how any item of information can affect more than one of the theory's predictors and hence produce correlations among them.

In the TPB, the link between intentions and behavior reflects how people tend to engage in behaviors that they intend to perform. However, Ajzen (1991) and Conner & Armitage (1998) emphasize that there is a complex interaction between perceived behavioral control and behavior as well, where individuals are more likely to engage in behaviors that they have control over and individuals are prevented from carrying out behaviors over which they have no control over. The authors suggest that even if intentions were held constant, behavior will be more likely to be performed with the increase of perceived behavioral control. Additionally, Ajzen (1985) also highlights that perceived behavioral control and intentions interact in their predictions of behavior such that intentions become strong predictors of behavior as the perceived behavioral control increases.

In this study of investigating maple producers' technology adoption behavior, the conceptual framework is developed by hypothesizing interrelationships among TPB constructs; attitudes, subjective norms, and perceived behavioral control towards technology adoption behavior (Ajzen, 2020). In addition, perceived behavioral control in adopting technologies is hypothesized to directly influence behavior (Ajzen, 1985;

Ajzen, 1991; Conner & Armitage, 1998). As per prior conceptual and empirical studies, this study investigates the effect of background factors on the TPB constructs as well. Although Ajzen (2020) indicates the presence of feedback effects of behaviors on attitudes, subjective norms, and perceived behavioral control, his models do not include the feedback loop as other constructs more importantly predict the behavior (Ajzen, 2015). The developed conceptual framework based on these interactions, links, and mediating effects is represented in Figure 8.

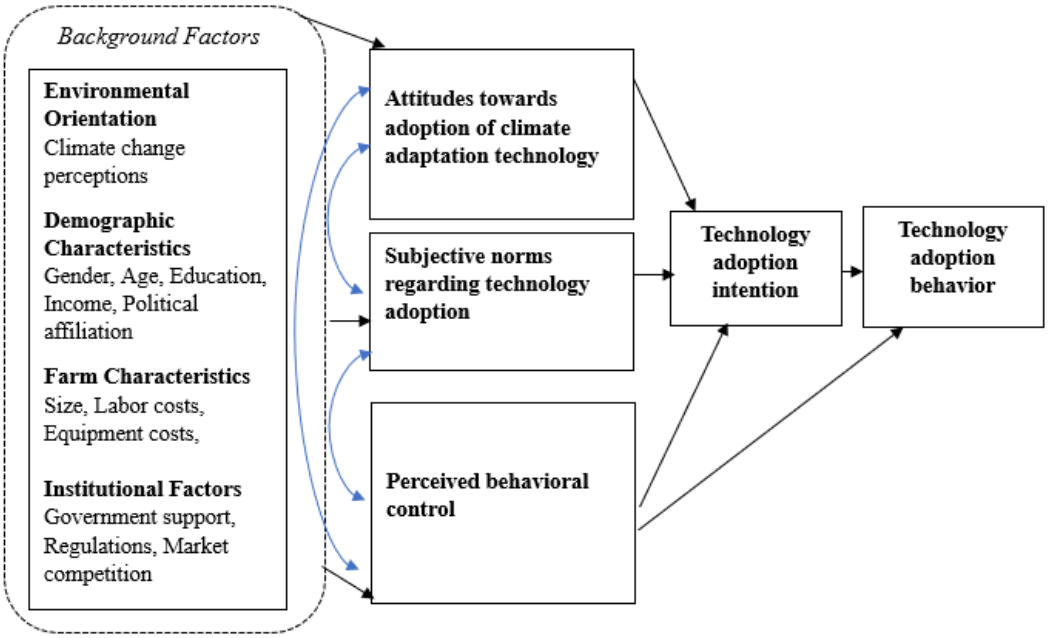


Fig. 8. Conceptual Framework for Technology Adoption Behavior of Maple Producers Adapted from the TPB

Methods

Data and Variables

In 2023, Vermont produced approximately 2.05 million gallons of maple syrup, which is a 20% reduction from the previous year's historic production of maple syrup in Vermont (USDA, 2023). According to the USDA (2023), Vermont maple producers put out 6.35 million maple taps in 2023, a decrease of 5% from the 2022 total. According to Center for Rural Studies at the University of Vermont, most Vermont maple producers are small and independent makers with an average of 3,451 taps that produce 1,221 gallons of syrup (Atlantic Corporation, 2019). However, the report indicates that the relatively small number of large-scale operations with over 5,000 taps produce the majority of maple syrup of the state. Vermont remains the leading

maple syrup producer in the country for numerous reasons, including, its wealth of natural resources, landscape, and long-lasting production seasons for freezing and thawing (Atlantic Corporation, 2019). According to the USDA (2018), Vermont has the longest seasons in recent years, compared to other top-producing states, typically ranging from January through mid-May. In Vermont, maple is a key agricultural enterprise and is the fourth most valued agricultural commodity of the state based on cash receipts (USDA, 2013).

While contributing between $140 and $144 million in value added through profits and wages, the maple sector also generates employment for between 3,000 and 4,500 people (Center for Rural Studies – UVM, 2015). The maple sector in Vermont is constituted by around 1,800 to 3,000 maple producers, 24 licensed packers and processors, and more than 100 enterprises that represent maple equipment manufacturers, dealerships, and sap collection infrastructure installers (Center for Rural Studies – UVM, 2015). In this study to investigate small and medium scale maple producers in Vermont and their technology adoption behaviors related to perceptions of climate change, we classify small and medium-scale producers as those with less than 10,000 taps (Caughron et al., 2020).

To investigate the technology adoption behavior of maple producers and their perceptions of climate change impacts on maple operations, we utilize data collected by the *2020* and *2023 Vermont Maple Producers' Surveys*. The Center for Rural Studies at the University of Vermont administered the surveys in collaboration with the Department of Community Development and Applied Economics at the University of Vermont. The data were collected using multiple methods that included online, telephone, and in-person surveys of maple syrup producers in Vermont, who were contacted using publicly-available, online sources, including Vermont Food

Systems Atlas, the Northeast Organic Farming Association of Vermont's (2019) list of certified organic producers, the Vermont Maple Sugar Makers' Association (2020) directory of member operations, and at two Vermont Maple Conferences in Brattleboro and Hyde Park, Vermont.

The survey consisted of structured and unstructured questions that inquired about different technologies adopted by maple producers, producers' demographic characteristics, farm characteristics, market characteristics, regulations, cost perceptions, perceptions of climate change, and TPB constructs related to technology adoption behavior. The questionnaire consisted of items that inquired about the adoption of technologies such as tubing, reverse osmosis, digital grading, fuel sources, vacuum pumps, etc. using binary responses. For analysis, we aggregated the technologies as a scale by adding all 'Yes'-coded responses. These technologies include vacuum delivery, tap hole sanitation, gas and battery-powered tree tappers, plastic tubing, spout technology, reverse osmosis systems, pre-heaters, high-tech monitoring systems such as digital graders and digital refractometers (Matthews et al., 2013; Legault et al., 2019; Caughron et al., 2020; Ahmed et al., 2023).

Climate change perceptions of maple producers were recorded in eight climate change perceptions statements, having 7-point Likert scale responses. These included producers' perceptions towards climate change threatening maple operations, adaptability to climate change, noticeable impacts of climate change, if projected impacts of climate change are exaggerated, if tapping season is early due to climate change, variability in sap season, perceived ease to determine the tapping time, and if maple dieback is observed due to climate change. Barriers to the maple operation were identified through producers' perceptions towards the costs associated with labor, fuel, equipment, and other constraints such as low maple prices, low quality

syrup, producers' health, farm succession, and the burden of regulatory compliance using Likert scale responses that range from 'Very concerning' to 'Not at all concerning'. Producers' perceptions towards market competition from other producers in Vermont, the US, Canada, large scale producers, the loss of family farms, and competition from artificial maple syrup were inquired using Likert scale responses.

The survey inquired about specific TPB constructs in terms of perceived behavioral control, attitudes, and subjective norms. Attitudes towards the adoption of technologies were operationalized using the item "*I think it is very important to use new technologies for maple production*" using a 5-point Likert scale. Similarly, subjective norms were operationalized using the statement, "*The current use of maple technologies on farms in Vermont is in line with society's expectations of maple production*", and perceived behavioral control using the statement, "*I think that the maple technologies I use will help me adapt to any climate-related challenges that my maple operation faces*". The TPB constructs, however, only appeared in the *2023 Vermont Maple Producers' Survey.* The survey did not specifically inquire about producers' intention to adopt technologies, however inquired about producers' intention to expand their operations. We used this variable as a proxy to measure the intention to adopt more technologies in the future (Tauer, 1987). The survey inquired about the perceived viability of the operation through a categorical variable where producers indicated if the operation was "*Economically viable*", "*Sustainable*" or "*Vulnerable*" as perceived by them. In addition, the change in profitability of the enterprise over the past 10 years was inquired to determine the perceived financial viability of the operation. Other farm characteristics such as income from maple, number of taps, and amount of syrup produced were collected as background factors.

In addition, producers' demographic characteristics in terms of gender, age, education, household income, and political affiliation were gathered.

Demographics

The *2020 Vermont Maple Producers' Survey* collected data from a sample of 106 producers and the *2023 Vermont Maple Producers' Survey* collected data from a sample of 68 maple producers. We identified 46 respondents who answered both surveys and they were matched as a panel data set for analysis. The panel data sample consisted of producers ranging from an age of 27 years to 92 years with a mean age of 61.4 years (SD = 12.9 years). A majority of the respondents identified as male (77.8%), and the rest identified as female (22.2%). A majority of producers (38.1%) have earned a bachelor's degree, while 9.5% have earned a graduate degree. Most producers were independent or center-leaning in their political affiliation (40.3%), whereas 38.7% identified themselves as Democrats and 21.0% identified as Republicans. Out of the sample, 40.2% of the producers earned an annual household income greater than $100,000, while 25.2% of the producers earned less than $50,000. The mean of the percentage income earned from the maple operation was recorded as 26.7% (SD = 27.4%) across the sample of producers, with some reporting that they didn't earn any income from the maple operation, while some indicating their income was 100% from the maple operation. Most of the producers in the sample have been producing maple for over 20 years (56.7%) and most of them were operating with on-farm or family labor (77.0%) while very few had hired labor for their businesses (23.0%). The number of taps in the maple operation of the sample ranged from 100 taps to 30,000 taps, with a mean of 6,867.3 taps (SD = 7,283.4 taps). Based on the greater distribution of larger producers in the sample according to the

current size classification, it may be better to incorporate a broader size classification for the sample (Velardi et al., 2023). Since the panel data sample is small, we retained all producers as small and medium-sized producers to avoid losing observations.

Data Analysis

Prior to analyzing data, we converted variables to a form ready to be included in the regression model. We converted the climate change perceptions statements to one 'Climate change perceptions' variable by aggregating the statements to an index using Principal Components Analysis (PCA). The PCA yielded one principal component with an Eigen value of 3.88, that explained 48.51% of the variation of the climate change perceptions statements. The climate change perceptions index was predicted using this component, loaded on to the eight climate change perceptions statements. Similarly, we predicted an index for the 'External competition' faced by maple producers by aggregating producers' perceptions regarding competition from other producers in Vermont, the US, Canada, and large-scale producers and artificial maple substitutes, and threat to the loss of family farms. The PCA yielded one principal component with an Eigen value of 2.52, that explained 41.96% of the variation of the market competition perceptions statements. The external competition index was predicted using this component, loaded on to the six external competition statements.

We conducted Multiple Linear Regression (MLR), Poisson Regression, and a Structural Equation Model (SEM) to analyze data according to the TPB. We detail further our reasons for conducting these separate statistical analyses. The first regression analysis was an MLR, where the outcome variable was the number of technologies adopted, and the predictors were producers' attitudes towards climate change, attitudes towards technology adoption, perceived behavioral control towards

technology adoption, perceived social norms regarding technology adoption, farm characteristics such as number of years in operation, percentage income from the maple operation, perceived farm viability, perceptions about labor costs, fuel costs, equipment costs, and external competition concerns, and demographic characteristics such as age, gender, education, household income, and political affiliation. We conducted MLR as a preliminary test to generally understand the relationships between the predictors in the model with the dependent variable prior to running SEM, which is a more comprehensive test. We ran the regression in four separate models, considering labor costs (MLR Model 1), equipment costs (MLR Model 2) and fuel costs (MLR Model 3), and concerns about external competition (MLR Model 4) separately, to avoid unreliable estimates arising from potential multicollinearity among these predictors (Scott, 1976).

We ran regression diagnostics tests for these four models to test the assumptions of linear regression. We confirmed the models as acceptable in terms of no evidence of multicollinearity after assessing for the Variance Inflation Factor (VIF) where each model had a VIF less than 5 (Thompson et al., 2017). We assessed and confirmed linearity between the outcome variable and each predictor variable of the four models using scatter plots with fitted lines (Weisberg, 2005). We confirmed homoscedasticity of the models using the Breusch-Pagan test for heteroscedasticity where each model displayed *p* values greater than 0.05 (Pagan & Pak, 1993). However, in testing multivariate normality, residuals of several variables in the model, including number of technologies adopted, age of producers, and the percentage income from the maple enterprise did not follow a normal distribution. Although we still ran the MLR models, we conducted more robust and applicable tests for testing hypotheses in our model, in terms of Poisson Regression and SEM as specialized nonlinear regression

models that did not require the assumption of normality of residuals (Pagan & Pak, 1993). We ran the Poisson Regression models similarly to the MLR models by considering labor, fuel, equipment, and external competition concerns separately. The assumptions of the Poisson Regression models were satisfied in terms of the dependent variable, number of technologies adopted, being a count model. We tested the Goodness of Fit (GOF) of these models and concluded that the model fits reasonably well since the GOF chi-squared test for all four models were not statistically significant (Gurtler & Henze, 2000). The MLR and Poisson Regression models that were run are as follows:

MLR & Poisson Model 1:

$$Number\ of\ Technologies = \beta_0 + \beta_1 Climate\ Change\ Perceptions + \beta_2 Attitudes + \beta_3 Perceived\ Behavioral\ Control + \beta_4 Perceived\ Social\ Norms + \beta_5 Years\ of\ Operation + \beta_6 Income\ from\ Maple + \beta_7 Viability + \beta_8 Labor\ Costs + \beta_9 Age + \beta_{10} Gender + \beta_{11} Education + \beta_{12} Household\ Income + \beta_{13} Political\ Affiliation + \varepsilon$$

MLR & Poisson Model 2:

$$Number\ of\ Technologies = \beta_0 + \beta_1 Climate\ Change\ Perceptions + \beta_2 Attitudes + \beta_3 Perceived\ Behavioral\ Control + \beta_4 Perceived\ Social\ Norms + \beta_5 Years\ of\ Operation + \beta_6 Income\ from\ Maple + \beta_7 Viability + \beta_8 Equipment\ Costs + \beta_9 Age + \beta_{10} Gender + \beta_{11} Education + \beta_{12} Household\ Income + \beta_{13} Political\ Affiliation + \varepsilon$$

MLR & Poisson Model 3:

$$Number\ of\ Technologies = \beta_0 + \beta_1 Climate\ Change\ Perceptions + \beta_2 Attitudes + \beta_3 Perceived\ Behavioral\ Control + \beta_4 Perceived\ Social\ Norms + \beta_5 Years\ of\ Operation + \beta_6 Income\ from\ Maple + \beta_7 Viability + \beta_8 Fuel\ Costs + \beta_9 Age + \beta_{10} Gender + \beta_{11} Education + \beta_{12} Household\ Income + \beta_{13} Political\ Affiliation + \varepsilon$$

MLR & Poisson Model 4:

$$Number\ of\ Technologies = \beta_0 + \beta_1 Climate\ Change\ Perceptions + \beta_2 Attitudes + \beta_3 Perceived\ Behavioral\ Control + \beta_4 Perceived\ Social\ Norms + \beta_5 Years\ of\ Operation + \beta_6 Income\ from\ Maple + \beta_7 Viability + \beta_8 External\ Competition + \beta_9 Age + \beta_{10} Gender + \beta_{11} Education + \beta_{12} Household\ Income + \beta_{13} Political\ Affiliation + \varepsilon$$

Although the MLR and Poisson Regression test for the presence of any linear relationship between predictors with the outcome variable, we could not visualize complex interactions between variables and the path model presented through our conceptual framework according to the TPB. Therefore, we conducted an SEM according to the hypothesized conceptual framework as a path model with observed variables modeled according to the TPB as in Figure 3. We discuss the specific hypotheses in the results section in separate figures to reduce complexity in Figure 9.

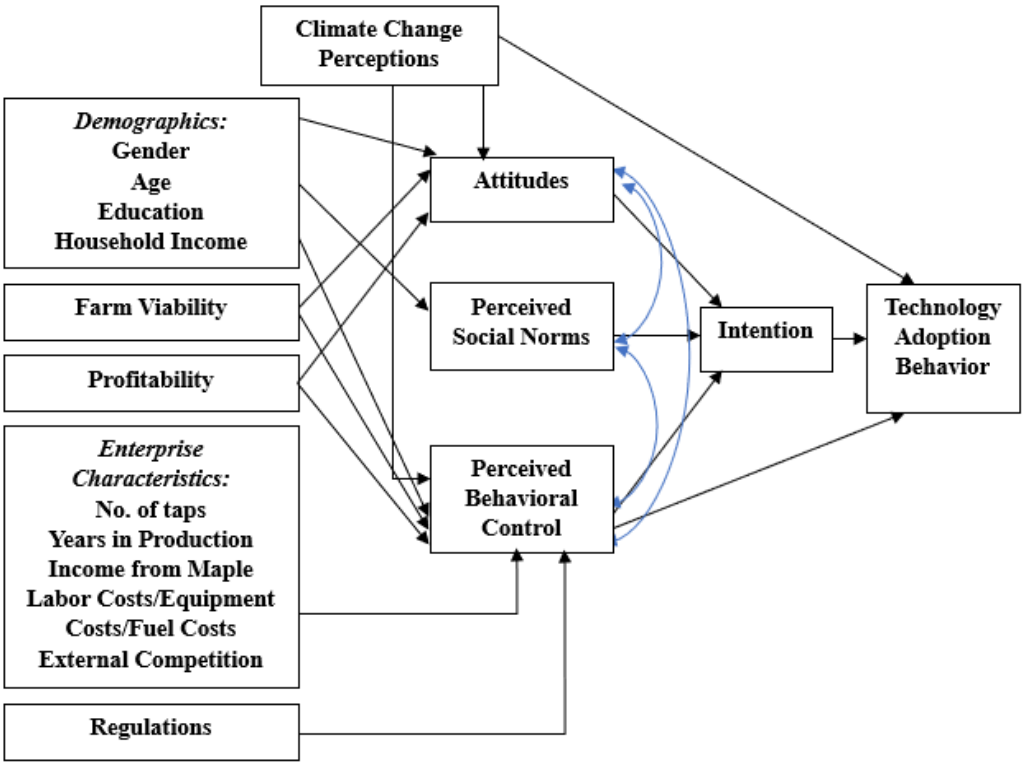


Fig. 9. Path Model for the SEM

Results

Technology Adoption as a Function of TPB Components

All four MLR models were significant ($p < 0.001$) and revealed several variables that were significantly associated with technology adoption behavior (number of maple technologies adopted) as represented in Table 6. MLR Model 1 explained 49.11% of the variation of the technology adoption behavior, MLR Model 2 explained 45.60% of the variation of the technology adoption behavior, MLR Model 3 explained 46.41% of the variation of the technology adoption behavior, while MLR Model 4 explained 45.58% of the variation of the technology adoption behavior. Therefore, all four models were considered to have good model fit with approximately half of the variance of the outcome variable explained by the predictors in the model.

Table 6

Results of MLR Models for Number of Maple Technologies Adopted as a Function of TPB Constructs and Farm and Household Characteristics

Variable	MLR Model 1		MLR Model 2		MLR Model 3		MLR Model 4	
	β	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*
TPB Constructs								
Attitudes	0.45	0.30	0.46	0.31	0.46	0.31	0.46	0.32
Perceived Social Norms	-0.29	0.33	-0.18	0.34	-0.18	0.34	-0.19	0.34
Perceived Behavioral Control	0.26	0.33	0.32	0.34	0.36	0.34	0.33	0.35
Climate Change Perceptions	-0.65**	0.29	-0.67**	0.30	-0.62**	0.30	-0.67**	0.31
Farm Characteristics								
Production Years	-1.13*	0.60	-1.14*	0.62	-0.98	0.64	-1.15*	0.62
Viability								
Sustainable	-1.12**	0.56	-1.03*	0.58	-1.10*	0.58	-1.03*	0.58
Vulnerable	-3.40**	1.36	-3.18**	1.40	-3.30**	1.40	-3.18**	1.41
Income from Maple	0.02**	0.01	0.02**	0.01	0.02**	0.01	0.02**	0.01
Labor Costs	1.03**	0.47						
Equipment Costs			0.09	0.58				
Fuel Costs					0.54	0.52		
External Competition							-0.01	0.13
Demographics								
Age	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02
Gender (Female)	0.89	0.58	1.01	0.62	0.93	0.60	0.99	0.60
Education								
Associate's degree or some college, no degree	-1.58**	0.73	-1.74**	0.75	-1.55**	0.77	-1.74**	0.77
Bachelor's degree	-0.55	0.75	-0.77	0.77	-0.50	0.81	-0.77	0.77
Master's degree or PhD	-1.00	1.00	-1.19	1.04	-0.78	1.10	-1.21	1.03
Political center	1.20*	0.68	1.18*	0.70	1.28*	0.70	1.19*	0.70
Political left	-0.23	0.73	-0.14	0.75	-0.08	0.75	-0.14	0.76
Household Income	-0.01	0.29	0.09	0.31	0.07	0.29	0.10	0.30

Note. β = Variable Coefficient; SE = Standard Error. *p value < 0.10, **p value < 0.05.

The subsequent Poisson Regression models were also statitically significant ($p < 0.001$) and revealed several variables that were significantly associated with the number of technologies adopted as represented in Table 7.

Table 7
Results of Poisson Regression Models for Number of Maple Technologies Adopted as a Function of TPB Constructs and Farm and Household Characteristics

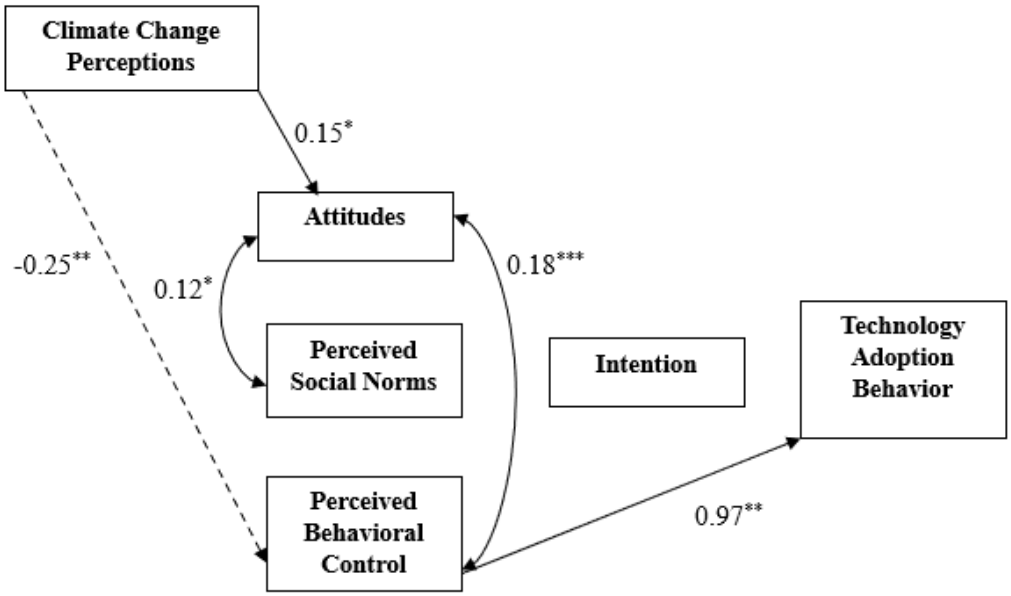
Variable	Poisson Model 1		Poisson Model 2		Poisson Model 3		Poisson Model 4	
	β	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*
TPB Constructs								
Attitudes	0.11	0.08	0.10	0.08	0.09	0.08	0.10	0.08
Perceived Social Norms	-0.04	0.08	-0.02	0.08	-0.01	0.08	-0.02	0.08
Perceived Behavioral Control	0.05	0.08	0.07	0.08	0.08	0.08	0.07	0.08
Climate Change Perceptions	-0.12*	0.06	-0.12*	0.06	-0.10*	0.07	-0.12*	0.07
Farm Characteristics								
Production Years	-0.24*	0.14	-0.24*	0.14	-0.22	0.14	-0.25*	0.14
Viability								
Sustainable	-0.23*	0.12	-0.21*	0.12	-0.24*	0.13	-0.21*	0.12
Vulnerable	-1.10**	0.48	-1.05**	0.48	-1.10**	0.48	-1.05**	0.48
Income from Maple	0.004**	0.002	0.004*	0.002	0.004*	0.002	0.004**	0.002
Labor Costs	0.22**	0.10						
Equipment Costs			0.000	0.12				
Fuel Costs					0.12	0.11		
External Competition							-0.003	0.03
Demographics								
Age	0.002	0.004	0.003	0.005	0.003	0.005	0.003	0.005
Gender (Female)	0.15	0.12	0.18	0.13	0.16	0.12	0.18	0.12
Education								
Associate's degree or some college, no degree	-0.34**	0.16	-0.37**	0.16	-0.33**	0.16	-0.37**	0.17
Bachelor's degree	-0.10	0.17	-0.14	0.17	-0.09	0.17	-0.15	0.17
Master's degree or PhD	-0.15	0.22	-0.22	0.23	-0.12	0.24	-0.22	0.22

Political center	0.22	0.15	0.21	0.15	0.23	0.15	0.21	0.15
Political left	-0.04	0.16	-0.03	0.16	-0.02	0.16	-0.03	0.16
Household Income	-0.004	0.07	0.03	0.07	0.02	0.06	0.03	0.07

Note. β = Variable Coefficient; SE = Standard Error. $^{*}p$ value < 0.10, $^{**}p$ value < 0.05.

Path Analysis of Maple Technology Adoption as a Function of TPB Constructs and Farm and Household Characteristics

The results of the SEM are represented according to the path analysis' results in Figures 10, 11, and 12. Figure 10 represents the path analysis results of the core TPB model, indicating the effects of variables among technology adoption behavior, intentions, attitudes, perceived social norms, perceived behavioral control, and climate change perceptions, excluding the background factors of demographics and farm characteristics. Figure 11 represents the path analysis results of how background factors are associated with attitudes, whereas Figure 12 represents the effects of background factors on perceived behavioral control. The path analysis did not reveal any significant associations between background factors and perceived social norms, and hence the path analysis of background variables influencing perceived social norms is not represented in any figure. The single-headed arrows imply the direction of assumed causal influence while the numerical values next to the arrows are standardized path coefficients. Paths that are not statistically significant (p value < 0.10) are not depicted in the following figures.

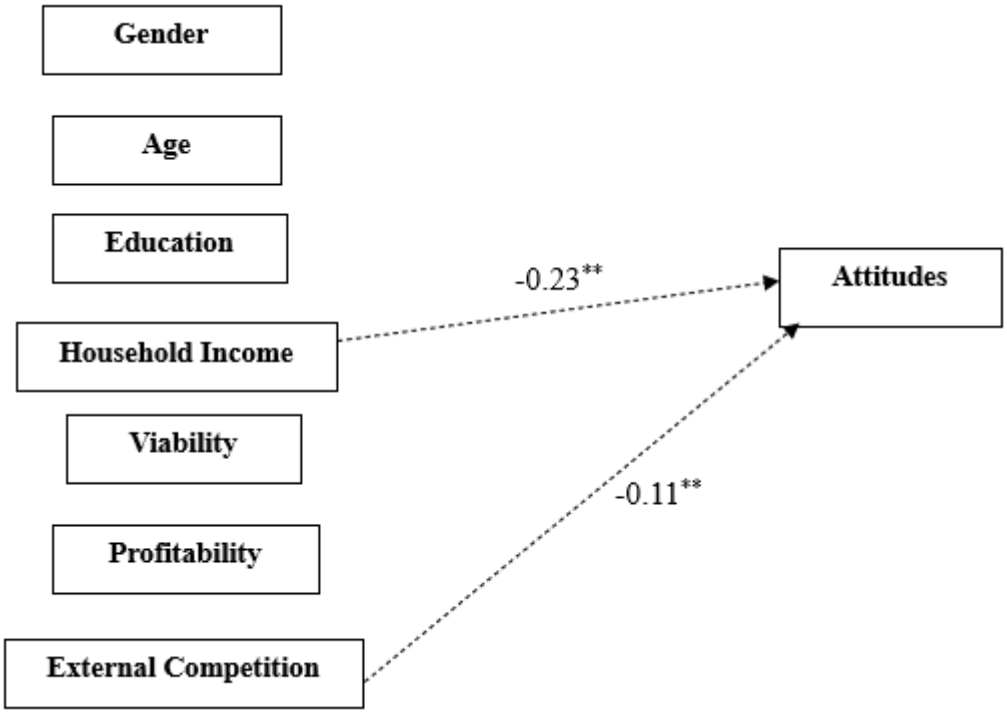


*p value < 0.10, **p value < 0.05, ***p value < 0.01

——▶ Direct positive effect

- - - - - - - - - - ▶ Direct negative effect

Fig. 10. Path Model Analysis for TPB Constructs

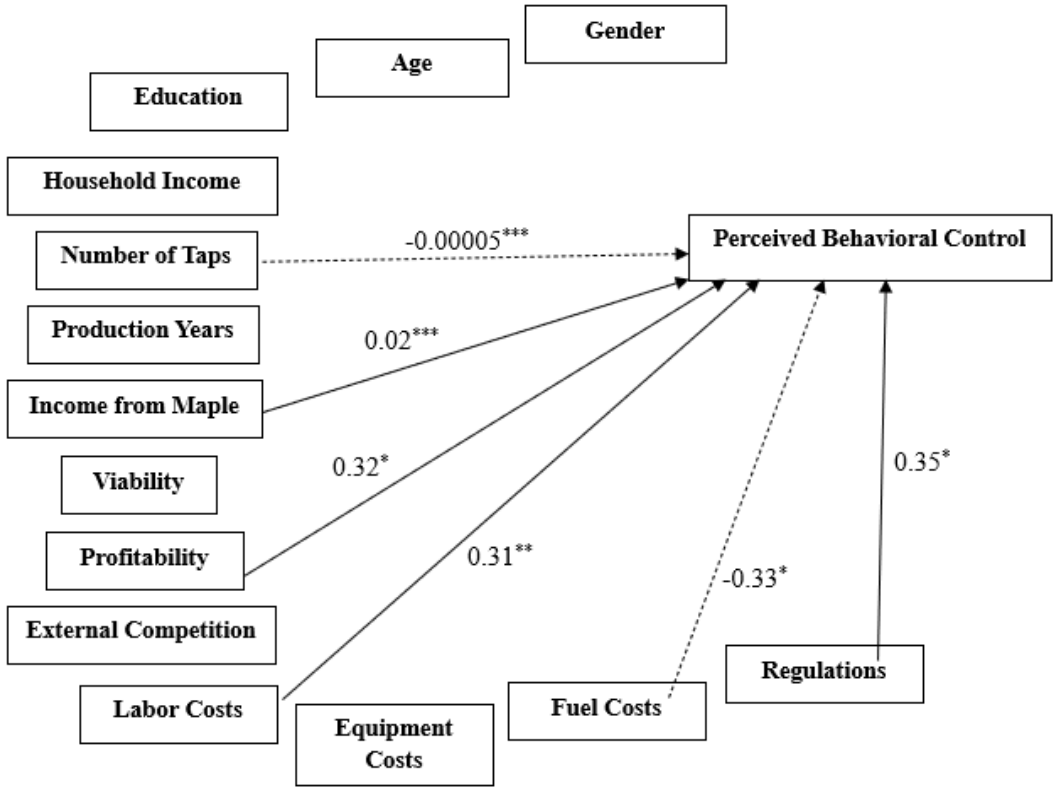


*p value < 0.10, **p value < 0.05, ***p value < 0.01

——▶ Direct positive effect

----------► Direct negative effect

Fig. 11. Path Model Analysis for Effect of Background Factors on Attitudes



*p value < 0.10, **p value < 0.05, ***p value < 0.01

——————► Direct positive effect

----------► Direct negative effect

Fig. 12. Path Model Analysis for Effect of Background Factors on Perceived Behavioral Control

Goodness of Fit of the SEM is poor in terms of Root Mean Squared Error of Approximation (RMSEA) ($p > 0.05$). The small sample size and small degrees of freedom in the model could have resulted in elevated values for the RMSEA (Taasoobshirazi & Wang, 2016). The Comparative Fit Index (CFI) of the model was not close to 1 (CFI = 0.437), that could also have resulted from the small sample size in the study (Taasoobshirazi & Wang, 2016). However, the coefficient of determination (R^2) is satisfactory where 70.5% of the variability of technology

adoption behavior is explained by the model and the hypothesized relationships between the variables in the model indicating a strong model in terms of its predictive power.

Discussion and Conclusions

The results of the regression models show several variables that are significantly and directly associated with the technology adoption behavior of maple producers in the sample. Results show that climate change perceptions of maple producers are significantly negatively associated with their technology adoption behavior (MLR – $p < 0.05$; Poisson – $p < 0.10$). Although we hypothesized that producers who are more concerned about climate change impacts would be adopting more climate change adaptation and mitigation technologies as indicated in prior literature (Legault et al., 2019; Cannella et al., 2022; Ahmed et al., 2023), our study suggests that producers who are more concerned about climate change impacts are less likely to adopt more technologies. As indicated in prior literature (Caughron et al., 2020), when compared to large scale producers, smaller scale producers may be less reluctant to adopt more technologies even though they are concerned about climate change due to financial constraints and their reluctance to change already-established practices. These findings also align with studies that indicate although technology adoption could be a potential climate adaptation and mitigation strategy, it is a short-term strategy that producers do not view as sustainable to have a resilient operation in the long-term (Ahmed et al., 2023). In addition, some technologies could in fact exacerbate climate change impacts further in terms of consuming excess energy such as the use of gas and battery-powered tree tappers and pre-heaters. Therefore, producers who are concerned about climate change may not be willing to adopt technologies that

consume excess energy and produce emissions, although they would help increase productivity in the operations by increasing tap timing and extraction efficiency in the presence of climate change impacts.

As Hinrichs (1995) and Ahmed et al. (2023) indicate, although producers are concerned about climate change, they would be hesitant to adopt new technologies over concerns in preserving traditional management practices and for the value of heritage. This was evident to some extent through our study as well, where producers who have been in the industry for a long time, over 20 years are less likely to adopt more technologies ($p < 0.10$), which could be due to their need to preserve traditional management practices and heritage, or their reluctance to change their established practices. Our study also indicated how certain farm economic factors influence producers' technology adoption behavior. Compared to an economically viable operation that has the capacity to cover all costs, pay family labor at the average agricultural wage, and generate a profit, operations that were considered to be sustainable but not economically viable ($p < 0.10$), and vulnerable ($p < 0.05$) significantly adopted less technologies. Similarly, the income from maple was positively associated with technology adoption behavior ($p < 0.05$), suggesting that producers who receive a higher share of income from their maple operation were more likely to invest in technologies towards their operation. These findings support prior studies that indicate the importance of financial capacities and capabilities of producers to invest in new technologies (Kuehn et al., 2017; Caughron et al., 2020). It is also noteworthy to recognize that producers are more likely to adopt technologies if they experience tangible benefits to their production from an economical point of view. Findings also indicate that producers who were more concerned about labor costs significantly adopted more technologies ($p < 0.05$), in accordance with prior

studies that emphasize how technologies reduce labor costs for producers, resulting in cost-savings for the long-term (Whitney & Upmeyer, 2004).

Compared to being high school educated or less than a high school graduate in terms of the highest educational qualification attained, producers who were having an associate degree or some college level education, but no degree significantly adopted fewer technologies ($p < 0.05$). Although studies indicate how education can be a measure of an individual's capacity to adopt management practices or technologies (Legault et al., 2019), many studies have not found significant associations between formal education and adoption behaviors in agriculture (Baumgart-Getz et al., 2012). This may explain why we did not observe any significant associations between technology adoption behavior with other levels of educational attainment such as bachelor's degree or post-graduate degree levels compared to high school educational attainment. As Baumgart-Getz et al. (2012) indicate, in this case, education through extension training might be a better measure to assess individual capacities that encourage adoption behaviors. The MLR results also indicated a significant positive association between producers who were politically center leaning or independent and technology adoption behavior, compared to producers who were right leaning ($p < 0.10$). Although this agrees with studies that indicate that producers who are progressive in their political views were more likely to adopt technologies (Thomas, 2021), it doesn't explain as to why we did not observe a significant difference between technology adoption behavior among politically left leaning and right leaning producers.

Although the MLR and Poisson Regressions indicated the variables that were significantly associated with the technology adoption behavior, we had to conduct an SEM to visualize how producers' psychological attributes mediated the relationships

among these variables, employing the TPB. Through the linear regressions, we observed a significant negative association between producers' climate change perceptions and technology adoption behavior, although the SEM (path model) showed that climate change perceptions are associated with the technology adoption behavior through producers' perceived behavioral control. Perceived behavioral control indicates the producers' perceived ability to perform or not perform the behavior (Ajzen, 1991), emphasizing their perceptions of the ease or difficulty in adopting technologies to adapt to or mitigate perceived climate change impacts. As per the TPB (Ajzen, 1991), we found that perceived behavioral control directly influences producers' technology adoption behavior ($\beta = 0.97$, $p < 0.05$), indicating a strong positive relationship where higher the producers' perceived behavioral control they are more likely to adopt climate change adaptation or mitigation technologies. Moreover, the study indicated that producers who were more concerned about climate change impacts on their maple operation perceived less behavioral control to adopt climate change adaption or mitigation technologies ($\beta = -0.25$, $p < 0.05$), aligning with the findings of Bradley et al. (2020) in how climate change risk perceptions affect self-efficacy in exhibiting climate change adaptation or mitigation behaviors. This emphasizes how although producers' perceived behavioral control is an important predictor of their technology adoption behavior, climate change risks that are external to the control of maple producers would affect their own behavioral control and perceived ability to adapt to climate change impacts.

Similar to the findings of Li et al. (2021), we found that producers' attitudes towards adopting climate change adaptation technologies are influenced by their climate change risk perceptions ($\beta = 0.15$, $p < 0.10$). We found a positive association among these variables, indicating how producers' who were more concerned about climate

change perceived the importance of adopting climate change adaptation or mitigation technologies, but were constrained by their ability and perceived behavioral control to do so. As found by Ajzen (2020), our study also indicated how the TPB constructs (attitudes, perceived social norms, and perceived behavioral control) are correlated with each other. The study found that attitudes and perceived behavioral control are highly significantly correlated with each other ($\beta = 0.18$, $p < 0.01$) and attitudes and perceived social norms are correlated with each other with a marginal significance ($\beta = 0.12$, $p < 0.10$).

In contrast to the studies that indicate how intentions predict behaviors, our study did not reveal a significant effect of intention on behavior. This could be due to the limitation of our study in terms of the variable measuring intention (intention to expand the maple operation) being a proxy measure of intention to adopt technologies and not a direct measure. Despite studies indicating that farmers' climate and market adaptation intentions are influenced by attitudes, perceived social norms, and perceived behavioral control (Senger et al., 2017), our study did not reveal significant associations between these psychological factors and intentions, possibly due to the same reason of intentions being poorly measured in this study. However, the significant influence of perceived behavioral control and actual behavioral control exhibited through maple producers' financial capabilities in adopting technologies align with studies that indicate how farmers' perceived ability and actual ability may influence their technology adoption decisions (Lynne at al., 1995).

Our study did not suggest a significant influence of attitudes on intentions or behaviors as exhibited through studies that found that attitudes strongly influence farmers' climate adaptation practice adoption (Faisal et al., 2020). However, as presented by prior studies (Faisal et al., 2020), farmers' risk perceptions towards

climate change seem to significantly influence their attitudes towards climate change adaptation practice adoption. While this study did not exhibit a significant influence of attitudes and perceived social norms on technology adoption behaviors, Velardi et al. (2023) found that Maine maple producers' size and scope decisions are influenced by their attitudes, but not by their perceived social norms. Similarly, this study did not exhibit any factors significantly influencing perceived social norms of maple producers that could allude that maple producers may be independent operators, rarely influenced by societal pressures or expectations towards decision-making in their maple operations.

In measuring how background factors such as producer demographics and enterprise characteristics influence the TPB constructs, we found that household income (β = -0.23, $p < 0.05$) and external competition (β = -0.11, $p < 0.05$) have a direct negative impact on attitudes (Ajzen, 2020). This indicates that households earning a higher income or who were more concerned about external competitions considered that adopting technologies was less helpful to adapt to climate change. This could mean that producers who were wealthier might have other strategies or income sources that would help them adapt to climate change impacts, and who were more concerned about external competitions may be more constrained by other risks than climate change that would motivate or demotivate them to adopt technologies.

Aligning with the arguments presented by Wheeler et al. (2013) and Ajzen (2020), this study found several maple enterprise and sector characteristics that directly influenced producers' perceived behavioral control. The size of the maple operation, in terms of the number of taps significantly negatively affected perceived behavioral control (β = -0.00005, $p < 0.01$), indicating that when operations become larger, producers perceived they would be less able to adapt to climate change through the

adoption of technologies. This is contrary to the findings of Caughron et al. (2020) where larger producers were more likely to invest in technologies. However, since all producers in this study were relatively small-scale producers, within this sample, having more taps might not mean that they were scaled operations that were resourceful to adopt more technologies. Supporting this argument and the findings of Farrel & Stedman (2013) and Legault at al. (2019), maple producers who obtained a higher share of their income from the maple operation ($\beta = 0.02$, $p < 0.01$) and who perceived their operations as more profitable ($\beta = 0.32$, $p < 0.10$) perceived higher behavioral control to adopt technologies. This indicates how having higher economic resources and capabilities would encourage maple producers' ability in themselves to adopt more technologies and adapt to climate change.

From an inputs-perspective, producers who were more concerned about labor costs perceived higher ability to adopt technologies ($\beta = 0.31$, $p < 0.05$) and those who were more concerned about fuel costs perceived lesser ability to adopt technologies ($\beta = -0.33$, $p < 0.10$). This aligns with the findings of Wheeler et al. (2013) in how producers' perceived behavioral control can be influenced by labor and other financial costs in adopting technologies. In investigating how concerns about industry regulations influence producers' perceived behavioral control, we found that producers who were more concerned about regulations perceived a higher ability to adopt technologies and adapt to climate change ($\beta = 0.35$, $p < 0.10$). Although this study did not inquire as to the specific types of regulations, regulations that require the use of technologies for product grading or quality assessments that could in fact help producers maintain profitable and sustainable operations may elevate producers' perceptions that technologies are helpful in adapting to climate change.

While regression analyses in this study showed that producers' climate change perceptions are associated with their technology adoption behavior, path analysis showed how other variables such as psychological attributes may mediate this relationship. Although producers perceive adopting technologies as a way to adapt to climate change and remain resilient, incorporating multiple sustainable strategies such as ecological management to remain resilient while mitigating effects of climate change would be useful for producers (Ahmed et al., 2023). Moreover, providing greater access to information and resources on adopting such technologies and ecological management strategies may be useful for producers to adapt to climate change impacts and maintain a viable operation. This study would be more useful and valuable, if it incorporated a qualitative research component in the future to understand in-depth maple producers' climate change perceptions and technology adoption behavior, and thereby contextualize these findings for designing policies.

Reflections

Unlike typical entrepreneurs operating in purely a business context, farmers as entrepreneurs operate in a multitude of contexts as business operators, land operators, agricultural producers, land stewards, and many more. Studying their entrepreneurial behavior is therefore very complex because such behaviors while being originated through farmers' personalities, identities, and psychological attributes, are also informed and influenced by external environmental conditions and market changes. But through this research, we can identify subtle ways in which farmers exhibit an entrepreneurial spirit and how farmers act and make decisions as entrepreneurs as opposed to farmers who predominantly operate as farmers, businesses and land operators with less of an entrepreneurial spirit. According to Krueger (1994), entrepreneurship itself is the pursuit of opportunities irrespective of existing resources, and such opportunity-seeking attitudes can distinguish potential entrepreneurs, leading to cultivating intentions of entrepreneurial behavior.

In this study, different types of behaviors that were identified as 'entrepreneurial behaviors' emerged through conversations with farmers. These behaviors included on-farm diversification, eco-entrepreneurship, innovation and technology adoption, and pluri-activity. Although all farmers in this study exhibited at least one or more of these behaviors, however, not all engaged in such behaviors because of entrepreneurial intentions or because they were motivated by an entrepreneurial spirit. For some farmers, the need to diversify or to engage in value-added production or to change their management practices towards more sustainable production was motivated by their opportunity-seeking attitudes, their innovativeness and creativity, their willingness to change, and their willingness to take risks and explore new opportunities, while satisfying their quest for new knowledge. These farmers may be

explicitly called entrepreneurial farmers. But for some farmers, the need to engage in diversification or value-added production or changing management was influenced by the various challenges and constraints they face in their operating environments. These farmers were seen to be 'pushed' to engage in such activities as an adaptation mechanism to various market and climate challenges they face, lacking entrepreneurial intentions, attitudes, or an entrepreneurial spirit. For example, some dairy farmers who do not receive a fair price for their milk expressed that they have to engage in other businesses such as agritourism on their farms to receive additional income and remain viable. Although this may look like these farmers are entrepreneurs, their motivations and attitudes were not entrepreneurial, but rather adaptive and resiliency-focused. These farmers are (sometimes reluctantly) forced to change their businesses out of necessity and may sometimes fail in these endeavors because they lack an entrepreneurial spirit. Therefore, the activities that these farmers carry out on their farms must be studied along with their motivations and psychological factors to identify if such behaviors are 'entrepreneurial behaviors' or 'market and environmental adaptation behaviors' (Vesala and Peura, 2003).

This is why farmers' entrepreneurial behaviors need to be studied along with farmers' decision-making behaviors and psychological attributes to understand the reason why they act in such a manner. Understanding such variations and changes in farmer behavior, that vary from one farmer to another is necessary in formulating policies. For example, in Vermont although entrepreneurship is highly promoted among farmers, most farmers seem to lack entrepreneurial intentions or they exhibit entrepreneurial attitudes that are uncharacteristic of entrepreneurial farmers, although they might be willing to take risks or change their operations out of necessity. For these farmers, understanding the constraints they face that force them to act in a

manner inconsistent with their goals, values, and identities need to be investigated to address the root cause of why small farms struggle to survive. In this case, formulating mechanisms to ensure a fair price for agricultural commodities, or extending resources for farmers to navigate environmental challenges are strategies that may be more beneficial to enhance the viability of these farms.

In conducting research that investigates farmers' behavior, it is also useful to incorporate psychological theories such as the TPB to understand how psychological attributes might explain why farmers act in certain ways. But the TPB seems to lack the theoretical angle in investigating how farmers' resilience and adaptation mechanisms are embedded within the broader social-ecological environment that farmers operate in. To better understand these complex interactions, there are other theories that could better incorporate the context of farmer behaviors, specifically to understand farmers' operating environment and influence of external/background factors on their attitudes, perceived social norms, decision making, and behaviors. Lynne et al. (1995) used the Theory of Derived Demand with the TPB to explain Florida strawberry farmers' conservation technology adoption behavior. In addition to farmers psychological attributes, the Theory of Derived Demand incorporated an economic reasoning that suggested the need to add actual financial control (product prices, technology prices, other input prices, capital) since self-reports of behavioral control may be inadequate in explaining farmer behavior (Lynne et al., 1995).

This study also highlights the importance of examining variation in entrepreneurial behavior in agriculture across sub-sectors. Although interviews with Vermont livestock farmers were notably concerned about societal expectations around farming and their subjective norms were associated with their behaviors, survey data from Vermont maple producers did not show a significant influence of social norms on

maple producers' behavior. In this case, to understand why some farmers are influenced by social norms and why others aren't, it may be beneficial to incorporate other theories in addition to TPB. Velardi et al. (2020) and Chang et al. (2023) investigated maple producers' knowledge exchange networks using the Adult Leaning Theory. Velardi et al. (2020) found that Maine maple producers rely on both formal and informal knowledge exchange facilitated by producer associations, while Chang et al. (2023) found that Wisconsin maple producers mostly learn through interactions with peers and underutilize expert resources, whereas opinion leaders and early technology adopters in the industry are more likely to seek information through both formal and informal knowledge networks than producers who are not influencers in the community. These studies explain the need to distinguish formal and informal social networks and producers' perceptions towards the norms of the different types of networks that may influence farmer behavior which is not explicitly differentiated and investigated through the TPB.

The TPB is also limited in understanding the social-ecological context that influences farmer behavior as a resilient adaptation mechanism. Wens et al. (2021) summarizes several behavioral theories that can be used to investigate farmer behavior and adaptation decisions. The agricultural adaptation and perceptions model (AAP) considers external vulnerabilities, climate impacts, challenges and obstacles, and other risk perceptions that influence farmers' adaptive behaviors (Below et al., 2015), while the technology acceptance model (TAM) (Szajna, 1996) and innovation diffusion model (Miller, 2015) consider feasibility and perceived usefulness and ease of use of technology, and the value-belief-norm theory (Stern et al., 1999) incorporates farmer values and beliefs around the consequences of exhibiting different behaviors. All may

be useful theories to investigate aspects of the external environment and farmers' internal motivations that are not captured by the TPB.

Future research investigating farmers' entrepreneurial behavior would benefit from a more comprehensive conceptual framework that captures farmers' internal motivations and the broader external context by combining multiple theories. This will help to capture entrepreneurial behavior as both a strategy that arises out of intrinsic motivation as well as something farmers engage in out of extrinsic motivation for increased adaptation and resilience.

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Appendices

Qualtrics Survey Instrument

Entrepreneurial Behavior of Small and Medium Scale Grazing Farmers in Vermont: Online Survey

1. Name of your farm:

2. For about how many years has your current livestock operation been in production?

    - Less than 5 years
    - Between 5-10 years
    - Between 10-20 years
    - Between 20-30 years
    - Between 30-40 years
    - More than 40 years

3. How many acres are there in your farm?
    - Owned:
    - Rented:
    - Unlisted:

4. What is the animal type on your farm? Please select all that apply.
    - Beef
    - Dairy
    - Sheep
    - Goat
    - Poultry
    - Other:

5. What type of beef operation does your farm engage in?
    - Cow-calf
    - Yearling / Stocker
    - Feedlot / Finishing
    - Other: Please specify

6. How many cattle on average does your cow-calf operation produce annually?
    - Cows
    - Calves

7. How many yearlings or stockers on average does your farm produce annually?

8. How many feeder cattle or finishers on average does your farm produce annually?

9. How many other beef cattle on average does your farm produce annually?

10. How many dairy cattle on average does your farm produce annually?
    - Calves
    - Yearlings
    - Heifers
    - Steers
    - Mature cows
    - Bulls

11. How many sheep on average does your farm produce annually?
    - Lambs
    - Ewes
    - Rams

12. How many goats on average does your farm produce annually?
    - Kids
    - Does / Nannies
    - Bucks / Billies

13. How many other animals on average does your farm produce annually?

14. What does your farm produce for the market? Select all that apply.
    - Milk
    - Value added dairy products (Cheese, butter, etc.)
    - Meat
    - Fiber
    - Cow-calf
    - Crops
    - Other:

15. How many people currently work on your farm? Please include all paid and unpaid labor.
    - On-farm or family (Male)
    - On-farm or family(Female)
    - On-farm or family(Another gender identifi cation)
    - Hired
    - Not listed

16. What infrastructure do you have on the farm? Please select all that apply.
    - Barns or livestock housing
    - Storage buildings
    - Power sources
    - Fencing
    - Water supply
    - Feeding infrastructure
    - Unlisted: Please specify

17. What management practices do you carry out on your farm? Please select all that apply.
    - Rotational grazing
    - Continuous grazing
    - Organic production
    - Grass-fed
    - Grass-finished
    - Cover cropping
    - Keyline plowing
    - Unlisted: Please specify

18. What certifications does your farm hold? Please select all that apply.
    - Organic
    - Grass-fed
    - Grass-finished
    - Rotational grazing
    - Animal welfare
    - Unlisted: Please specify

19. Does your farm generate income from activities other than farming?
    - Yes
    - No

20. What other businesses or enterprises do you have on your farm? List all.

21. Does your farm engage in value-added production?
    - Yes
    - No

22. What value-added production do you carry out on your farm? List all.

23. How do you sell your produce? Please select all that apply.
    - Direct sales
    - Wholesale
    - Online sales

- CSAs (Community Supported Agriculture)
- Farmers Markets
- Unlisted: Please specify

24. Does your farm have general farm insurance?
    - Yes
    - No

25. Do you use any computerized decision-support tools for your farming activities?
    - Yes
    - No

26. What mostly drives your decision-making in your farming activities?
    - I primarily consider financial costs and benefits
    - I primarily consider potential environmental impacts
    - I primarily consider family heritage and traditions
    - I primarily consider animal health and welfare
    - Other: Please describe

27. To what extent do the following factors concern you with respect to the long-term viability of your livestock operation?

	Very Concerning	Concerning	Unsure	Little Concerning	Not at all Concerning
Cost of equipment					
Availability of labor					
Cost of labor					
Low market prices for products					
Market competition from other producers					
Climate change					
Farm succession					
Burden of regulatory compliance					

External institutions (cooperatives, distributors, etc.)					
Loss of family farms					
Natural events (pest outbreaks, animal diseases, etc.)					
Physically operating your enterprise (age, ill health, etc.)					
Community and neighborhood dynamics					
Soil health					
Farm financials (capital, assets, debt, etc.)					
Changing consumer demand and lifestyle					

28. Please select the best description for your current livestock operation from the options below.
    - Economically viable: This livestock operation has the capacity to cover all costs, pay labor at the average agricultural wage, and generate a profit
    - Sustainable: This business does not meet the “economically viable farm” definition (above) but it is sustainable due to the presence of built-up equity or other income sources
    - Vulnerable: This business does not meet the “economically viable farm” definition (above) and does not have equity or other income sources

29. What do you think the description for your livestock operation will be in the next 5 to 10 years?
    - Economically viable: This livestock operation would have the capacity to cover all costs, pay labor at the average agricultural wage, and generate a profit
    - Sustainable: This business would not meet the “economically viable farm” definition (above) but it would be sustainable due to the presence of built-up equity or other income sources
    - Vulnerable: This business would not meet the “economically viable farm” definition (above) and would not have equity or other income sources

For the following questions, indicate your opinion, from “Strongly agree” to “Strongly disagree”.

	Strongly disagree	Disagree	Unsure	Agree	Strongly agree
30. I acquaint myself with everything before I make an important decision					
31. I tend to experiment with on-farm activities					
32. I adopt technologies created outside the farm on my farm					
33. I implement sustainable management practices through participation in R&D and extension projects					
34. I create innovative methods to market and sell my farm produce					
35. I involve farm workers in the generation and implementation of new ideas					
36. I use social media and/or mobile applications to access information about livestock farming					
37. I engage in farmer groups and organizations					
38. I use agricultural extension services to inform my farming practices					

39. I engage in knowledge-sharing with other farmers in the community					
40. I participate in agricultural workshops and conferences					
41. I engage with government agencies for farming activities					
42. I follow the agricultural policies of livestock production closely					
43. I always control my production targets and I make an analysis of my farm according to these results					

The following questions ask about your attitudes towards entrepreneurial activities. Please rate your responses from “Strongly agree” to “Strongly disagree”.

	Strongly disagree	Disagree	Unsure	Agree	Strongly agree
44. You cannot get ahead in farming unless you take some risks					
45. Expert advice makes the farmers enterprise/activities productive					
46. I find it important to diversify the business operation					
47. I believe in the importance of continuous learning and adaptation in farming					
48. I enjoy the challenge of solving problems and finding innovative solutions on my farm					
49. I think it is important to market and brand my farm produce					

The following questions ask about your self-efficacy in engaging in entrepreneurial activities.

50. I can afford to take a few risks and experiment with new ideas
    - Strongly disagree

- Disagree
- Unsure
- Agree
- Strongly agree

51. I have experienced risky situations before and am confident that I can manage risk well
    - Strongly disagree
    - Disagree
    - Unsure
    - Agree
    - Strongly agree

How much confidence do you have in your ability to:

52. Brainstorm a new idea for a product/practice/technology?
    - Not at all confident
    - Little confident
    - Moderately confident
    - Confident
    - Very confident

53. Could you please explain why?

54. Network – make contact with and exchange information with others?
    - Not at all confident
    - Little confident
    - Moderately confident
    - Confident
    - Very confident

55. Could you please explain why?

56. Deal effectively with day-to-day problems and crises?
    - Not at all confident
    - Little confident
    - Moderately confident
    - Confident
    - Very confident

57. Could you please explain why?

58. Manage the financial assets of your business?
    - Not at all confident
    - Little confident
    - Moderately confident

- Confident
- Very confident

59. Could you please explain why?

The following questions ask about perceived social norms in engaging in entrepreneurial activities. Please rate your responses from “Strongly agree” to “Strongly disagree”.

	Strongly disagree	Disagree	Unsure	Agree	Strongly agree
60. The opinions of my family about my farm are important for me					
61. The opinions of other farmers in the community about my farm are important for me					
62. The opinions of the community about my farm are important for me					
63. Most people I know approve the entrepreneurial activities I engage in with the farm					
64. I’m motivated by other farmers in the community who engage in entrepreneurial activities on their farms					
65. My farming practices are in line with Vermont society’s expectations around farming					

To what extent do you agree with the following statements about your future plans for the farm business?

	Strongly disagree	Disagree	Unsure	Agree	Strongly agree
66. I would (further) diversify my farm business					
67. I would change my management practices on the farm for regenerative agriculture					

68. I would adopt latest technologies					
69. I would participate in research grants					
70. I would change farm management to apply for certification schemes					
71. I would cater to additional markets					

Demographics.

72. What is your age?

73. What is your gender? Please choose only one of the following.
    - Male
    - Female
    - Unlisted gender affiliation
    - Prefer not to say

74. What labor do you employ on your farm?
    - On-farm or family
    - Hired

75. How many on-farm or family labor do you employ?

76. How many hired workers do you employ?

77. What is your approximate total annual household income?
    - Less than $10,000
    - Between $10,000 and $25,000
    - Between $25,000 and $50,000
    - Between $50,000 and $75,000
    - Between $75,000 and $100,000
    - Over $100,000

78. Please select the option that best reflects your educational attainment level. Please choose only one of the following:
    - Less than high school graduate
    - High school graduate or equivalent
    - Some college, no degree
    - College degree or equivalent (Associate's, Bachelor's, or higher)

Interview Question Guide

1. How do you view your relationship with farming?
   (– is it primarily a way of life, a business, or something other than that?)

2. What are your long-term goals as a farmer?
   (follow-up with prompts)

3. What keeps you motivated to farm?

4. What are some of the biggest risks you face in farming?
   - How do you remain resilient in the face of _____ [*each risk*], what helps you?

5. What factors mainly influence your decision-making in farming?
   (*Follow up with the following (rate them as: Not, Somewhat, Very, Extremely)*)
   - Economic viability
   - Environmental sustainability
   - Family and lifestyle
   - Community and social factors
   - Personal values
   - Not listed:

6. On a scale of 1 to 5, where 1 is "Not Willing at All" and 5 is "Very Willing," how willing are you to take risks on your farm to explore new opportunities?
   (Can you explain more?)

7. How open are you to adopting new farming technologies and practices? (Scale: Very Open, Somewhat Open, Neutral, Somewhat Resistant, Very Resistant)
   (Can you explain more?)

8. How much do you think the behaviors of other farmers in your community influence your own farm management decisions? (A lot, Somewhat, Neutral, A little, Not at all)

9. How confident are you in your ability to make strategic decisions for your farm that will help you achieve your farming goals? (Very confident, Somewhat confident, Neutral, Little confident, Not at all confident)

10. In your understanding, what does it mean to be entrepreneurial in farming?

    (The literature defines entrepreneurialism in farming as being alert to new opportunities, strategically oriented towards farming activities such as diversification, professional development through information-seeking

behaviors, market awareness, contributing to rural growth, high technology orientation, and cooperation and networking skills, and innovating (McElwee, 2008))

11. Do you consider yourself an entrepreneurial farmer? Can you explain why?