Extension Education

Challenges with Developing an Extension Program for Markets Evolving under an Uncertain Framework: Lessons from Program Development for Carbon and Hemp Markets

Charley C. Martinez[a], S. Aaron Smith[a], Tyler Mark[b], and Paul Goeringer[c]
University of Tennessee[a], University of Kentucky[b], and University of Maryland[c]

JEL Codes: Q13, Q15, Q16, Q19
Keywords: Carbon markets, Extension, hemp, new markets, programming

Abstract
Extension programs are the link between producers, applied research, and policy. Additionally, Extension educators are often the initial point of contact for producers when new agricultural markets emerge. Emerging markets provide opportunities and challenges for all producers. However, developing an Extension program to assist producers can be difficult due to limited production information (or process clarity), a lack of infrastructure, uncertain marketing channels, and uncertain policy direction. During the emergence of new commodities or markets, the development of Extension programming is necessary to aid producers and other agricultural stakeholders in clarifying the risks and rewards of entering or participating in the market. A further complication is a bimodal distribution of clientele ranging from those operators new to agriculture to established operators.

The development of carbon and hemp markets in the United States highlights the difficulties in providing producers with timely information when a highly uncertain policy and regulatory environment exists. This paper discusses how to develop an Extension program to address producers' needs for emerging markets effectively. Specifically, we highlight the benefits of collaboration, obtaining grant funding, program development, and identifying research topics. Finally, the program development discussed can be utilized by Extension educators when developing programming for future emerging markets.

1 Introduction

Extension programs provide a link between producers, applied research, and policy. This relationship often puts Extension educators as the first point of contact when new commodities, markets, or policies emerge in agriculture. While challenges occur with maintaining a successful Extension program, developing an Extension program that revolves around markets with unknown policy, undefined supply chains, and potential for above-average returns creates new challenges. In recent years, the hemp market and the emerging voluntary carbon credit market have presented Extension specialists with these challenges. The hemp market is not new. It is a reemerging one that was revitalized and spurred on by government policy via the Agricultural Act of 2014 (2014 Farm Bill) and the promise of extraordinary returns relative to other crops. The voluntary carbon credit market is another reemerging market that has gained interest from private and public sectors. The "new-ness" of these two markets has stimulated fluid conversations with agricultural producers, investors, and other businesses that want to either learn more or estimate if either is a worthy venture. Interest in these markets has led to Extension programming for agricultural producers and nontraditional Extension clientele. Hemp and carbon credit markets highlight the difficulties in providing producers with timely information when a highly uncertain policy and regulatory environment exists. This paper provides a brief overview of the industrial hemp and voluntary carbon credit markets and then discusses how Extension programs were developed to address producers' needs for emerging markets. Specifically, this paper highlights the benefits of

collaboration, obtaining grant funding, program development, identifying research topics, and challenges with program development, implementation, and evaluation.

2 Overview of Hemp

Interest in hemp production began with the 2014 Farm Bill and exploded with the 2018 Farm Bill. Original states allowing legal cultivation of industrial hemp included California, Colorado, Kentucky, Maine, Montana, North Dakota, Oregon, Vermont, and West Virginia (Mark and Snell 2019; Mark et al. 2020). Following the initial wave of interest, additional states legalized industrial hemp production from 2015 to 2021. Hemp can be grown for fiber, seed/grain, microgreens, and extract (e.g., Cannabidiol, CBD). However, the diversity of end uses in hemp creates challenges in Extension programming as the four general end use markets of hemp have very different production costs, prices, markets, contract terms, and supply chains.

Interest in industrial hemp production in the United States was initially driven by the extract market (primarily CBD). Primarily for this market, dried hemp buds are used, otherwise known as floral hemp or hemp flower. This material is harvested from the unfertilized female hemp plants. However, from 2018 to 2021, many variations of industrial hemp for CBD extract were attempted, creating a heterogenous product that ranged from handpicked hemp buds to stripped and chopped leaf and floral material. The heterogeneity of the product, combined with overproduction, led to large price ranges and eventually led to a price collapse. The price of floral material dropped from $4.25 per percent CBD to less than $0.20 in December 2021. Initial challenges for Extension educators in this market's reemergence in certain regions was providing stakeholders with accurate information on production practices, prices, and contracts. Producers were often drawn into industrial hemp production through elevated price expectations and contracts that promised high returns. Then, a series of reactions occurred when overproduction issues began to surface in 2019, prices fell, and processors defaulted on their contracts (NBC-LEX18 2019; *Schneider 2020; Olek 2021).* Examples include GenCanna Global in Kentucky, Eureka's93 in Montana, and Elemental Processing in Oregon. Contract defaults resulted in lawsuits filed across the country. In addition, in 2019, approximately 60 percent of the hemp crop was grown without a contract, leaving producers without any revenue to cover costs and/or hold this material until the oversupply could be processed. As a result, Extension programming priorities changed to working with producers to manage and avoid some of the downside risks they were now facing. Now that floral hemp price has fallen below the breakeven price for many producers, there has been an uptick in the interest in hemp grain, fiber, and microgreen production and understanding the demand for the extraction industry (Campbell et al. 2021; Kolodinsky and Lacasse 2021). Additionally, industrial hemp producers have become more skeptical of contracts and are acutely aware of counter party risk. A 2020 University of Tennessee survey indicated that in 2019, 22 percent of hemp growers in the state had signed a production contract; in 2020 that number decreased to 8 percent (Figure 1; Cui and Smith 2020). Thus, there has been another change in the Extension programming priorities across the United States. This market and Extension programming priorities will continue to shift as markets, regulations, and investment in the industry continues to evolve.

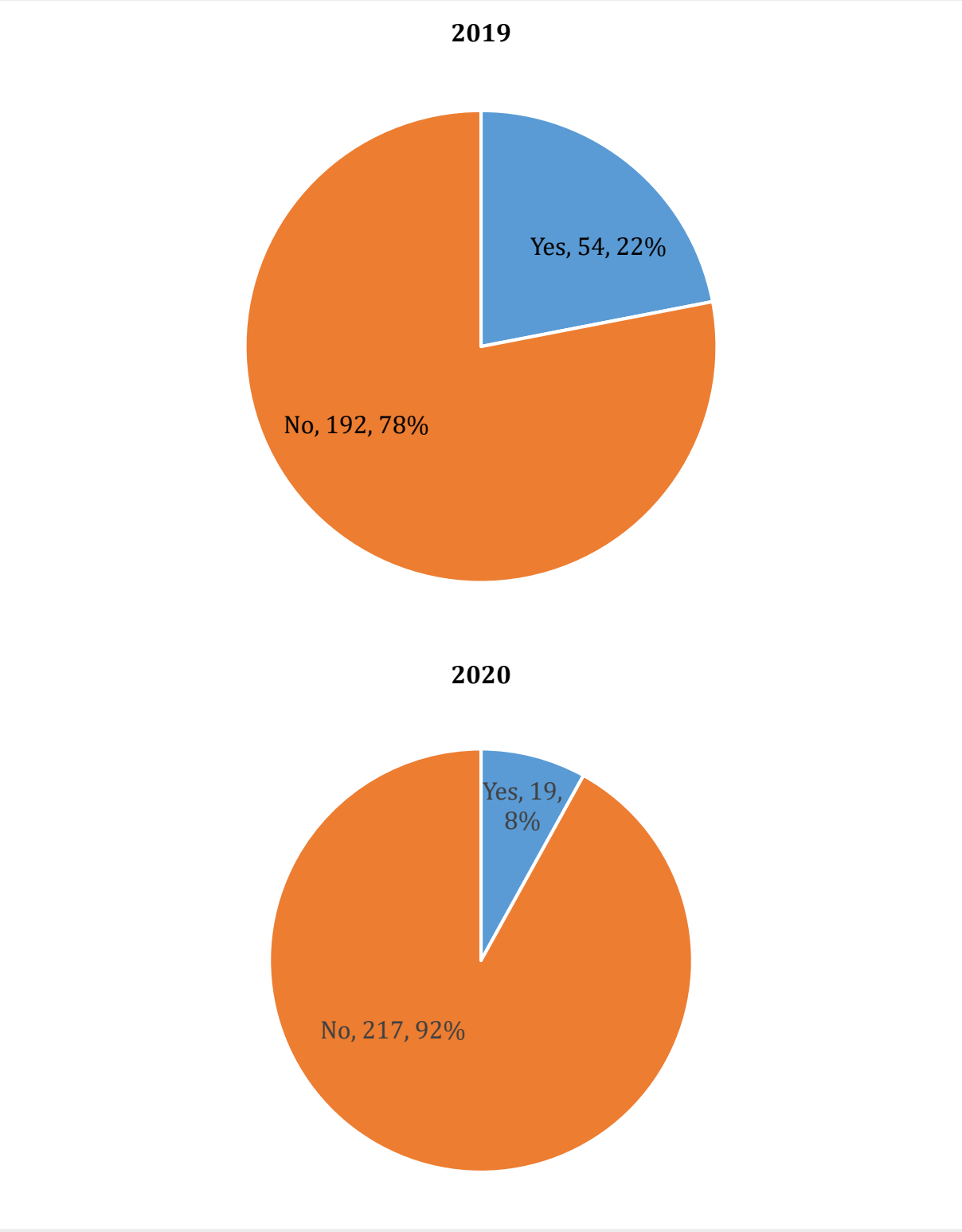

Figure 1. Tennessee Industrial Hemp Producers That Indicated They Had Signed a Contract with a Hemp Processor

Source: Cui and Smith 2020

3 Overview of Carbon Markets

The U.S. Environmental Protection Agency (EPA) estimates that the agricultural sector accounts for 10 percent of greenhouse gas emissions (GHG), a 12 percent increase since 1990 (U.S. Environmental Protection Agency 2021). Agriculture contributes direct (management of soils, livestock production, and manure management) and indirect emissions (U.S. Environmental Protection Agency 2021). These emissions can be lowered by implementing production practices, such as optimal fertilizer usage, improved soil management, and livestock feeding adjustments (U.S. Environmental Protection Agency 2021). These examples are practices that a producer can adopt in their production system to reduce GHG emissions. In addition to carbon emission reductions, agriculture can sequester carbon in the soil by managing forestlands, croplands, and grasslands. In the past, the reduction of and sequestration of GHGs was not attractive to producers because there was a limited financial incentive for such practices. This missing financial incentive for GHG emissions reduction and sequestration has led to the development of voluntary carbon credit market, which has market participants from the agricultural and nonagricultural sectors.

There are two variations of carbon markets: compliance (government-regulated limits of GHG emissions) and voluntary (Shockley and Snell 2021). As of December 2021, compliance markets have not been implemented nationally (California has implemented compliance markets at the state level). In 2020 and 2021, producer interest in carbon markets has been driven by voluntary carbon markets. Voluntary markets are based in the private sector and are completed by voluntary transactions between producers/landowners and carbon market participants. Current carbon market transactions occur in the private sector, making public data challenging to obtain. In addition, there is no consistency among companies in payment mechanisms, measurement, validation, and other terms and conditions because contracts are private.

A carbon credit is a transferrable credit certified by a government or an independent body that typically equates to 1 metric ton of GHG emissions reduction or sequestration (Nriagu 2021). Producers generate carbon credits by implementing carbon reducing or carbon sequestering practices. The adoption of GHG reducing practices or sequestration results in GHG emissions reductions compared to current practices (baseline). This change is often referred to as additionality.

Plastina (2021) summarized how data and payments flow through agricultural carbon credit markets. In general, producers sign contracts with a program developer to receive payments from sequestering carbon due to changes to production practices. The program developer designs the project, provides guidance on data, reporting, and modeling procedures, and acts as an intermediary between the producers, verifiers, registries, or emissions reduction purchasers. Verifiers provide technical expertise and "certify" the amount of carbon that has been sequestered or GHG emissions reduced. Registries provide a clearinghouse for carbon transactions to occur, ensuring that each carbon credit can be identified for sale. After carbon credits are verified and registered, carbon credits can be sold (either by the producer/landowner or by the program developer). Purchasers of carbon credits can be companies seeking to obtain carbon neutrality targets or those wanting to offset carbon emissions due to regulatory compliance.

Once the carbon credit is generated, it enters the market where buyers can purchase credits. Since carbon markets are still developing, limited pricing information is available. As a result, a great deal of uncertainty exists for landowners and producers on whether revenue from carbon credits will cover the cost and risk of implementing new management practices and transaction costs required to participate in carbon markets. Additionally, participation in current markets may have ramifications in participation in carbon and other ecosystem markets in the future. Uncertainty in the carbon markets has necessitated the need for Extension programming for producers, landowners, and other participants in this new market.

4 Extension Program Development Under Limited Information

Developing a well-rounded Extension program is challenging when timely and readily available information is unavailable to the educator. In both hemp and carbon markets, the unknowns about the supply chain, cost structure, contract terms, and price discovery generate large sources of risk for producers. For example, the amount of carbon sequestered, and practice(s) adopted, will vary from farm to farm, and each practice has different potential returns. Extension programming that helps producers understand the costs and risks of implementing new practices before entering a new market is critical. The challenges in developing budgets, price estimation, and market projections for clientele become difficult for an Extension specialist when price discovery is not transparent or well established. Additionally, Extension programs must be developed for both traditional and nontraditional clientele.

4.1 Identifying Target Audiences

Demand for information by stakeholders drives the need for Extension programming to support new industries. Although the information is limited, Extension programs can benefit from new markets due:

1. Greater program participation. For example, hemp meetings in Tennessee and Kentucky in 2018 and 2019 were attracting hundreds of participants. In addition, online webinars are still generating significant interest even with the drastic decreases in production nationwide.
2. Participation by audiences that have not been served by Extension in the past. A survey of a hemp Extension program in Murfreesboro, Tennessee, indicated that over 40 percent of those in attendance had previously never been to an Extension event. There is also some evidence that hemp attracted a more diverse clientele than traditional agriculture programs. A University of Tennessee webinar for hemp producers in 2019 had 154 registered participants—56 percent male, 42 percent female, 2 percent unknown; 69 percent white, 11 percent black, 2 percent Hispanic, 1 percent Asian, 1 percent Native American, 1 percent Pacific Islander, and 15 percent unknown. The 2017 census of agriculture indicated Tennessee producer demographics of 35 percent female, 65 percent male; 97 percent white, and 3 percent other (U.S. Department of Agriculture 2017).

For hemp markets, a wave of enthusiasm created high demand for immediate Extension programing. This created a substantial challenge for state specialists and county agents. Developing programs too quickly and with limited information can be counterproductive, even if demand for the programming is high. One of the most limiting but necessary responses to stakeholder questions is “I don’t know.” Stakeholders want answers to complicated questions, and Extension educators are there to assist in providing the answers. However, new or reemerging markets devoid of price, supply chain, and research-based production information can tempt educators to make statements that may not have robust or any impartial research-based information behind them. As such, Extension educators must be able to use qualifiers when discussing anecdotal claims to convey industry or personnel experiences as academic research. The inability to articulate the difference between research-based information and anecdotal claims can result in confusion and skepticism for those that attend Extension events.

4.2 Collecting Available Data

For new or reemerging markets, the availability of research-based unbiased data is challenging to obtain. In both hemp and voluntary carbon markets, existing data regarding hemp production prior to 1945 and carbon markets through European cap and trade systems and past domestic carbon policies provided a starting point. An alternative source of information for Extension educators was related commodities or markets. For example, agronomists discussing hemp for CBD production relied on vegetable and tobacco production information to help guide producers. Evaluating producer contracts for voluntary carbon

markets parallels other contractual arrangements between two parties that can guide the process such as poultry and land lease agreements. Historical information and components of related industries can provide a base to develop a preliminary Extension program.

A valuable tool can be conducting stakeholder surveys or focus groups to determine needs, information gaps, and suitable methods for program delivery, in addition to gathering information regarding current practices by early adopters (Cui and Smith 2020). Due to heightened interest in new or reemerging commodities or markets, this information is usually not robust and comes with a great deal of certainty. Generally, the information collected would not meet the requirements for publication in a peer-reviewed journal; however, information can be used to inform stakeholders and guide discussions.

4.3 Identifying Stakeholders, Collaborators, and Resources

4.3.1 Identifying Stakeholders

Identifying stakeholders and collaborators to develop and implement Extension programming is essential to success. The challenge is identifying groups that can work toward providing information that can move the industry forward. Early participants in hemp markets can be useful sources for information regarding industry trends and needs for Extension and research. Caution does need to be exerted when partnering with individuals or groups that may have ulterior motives (such as product sales). Additionally, very few groups have shown the ability to remain cohesive with common goals that the group can coalesce around. Validating claims provided by an industry collaborator can be a challenging undertaking for Extension educators due to limited or no access to privately held information. Thus, Extension educators are subject to two challenges, providing affirmation of correct information and repudiation of inaccurate information.

Forging strong partnerships with state, regional, and national universities and governments can facilitate rapid data and information exchange when it becomes available. In hemp, various producer or hemp advocacy groups were formed to provide a unified voice for hemp producers, processors, and other stakeholders in individual states. For example, in Maryland, Extension faculty found working with agricultural groups focused on educating nontraditional producers to enter agriculture to be good partners to assist in getting information out to new growers. At the same time, working with existing programming being done by county governments in Maryland on hemp was a good platform as well. In Tennessee, Extension partnered with the Tennessee Department of Agriculture (TDA) to host over 20 meetings across the state to inform hemp stakeholders. Organizing and conducting the meetings allowed for information to be distributed to stakeholders and helped ensure that information between University of Tennessee Extension and TDA was readily shared, and a uniformed message conveyed. For carbon credit programing, working closely with U.S. Department of Agriculture (USDA) Natural Resources Conservation Service provided the opportunity to present information on economics and contracting alongside production practices and implementation strategies. On-site field days demonstrating production practices, such as cover crops, followed by questions regarding producer considerations when evaluating carbon contracts were well received by producers.

4.3.2 Identifying Resources and Collaborators

Initially, obtaining resources to conduct hemp research and Extension programming was challenging. However, this is changing as the industrial hemp industry matures and policy clarity is provided. Inflows of external funding, such as USDA and state government, often lagged demand for programming to conduct Extension programs. Governmental funding often focuses on research questions identified by Extension personnel; however, limited funding was initially available to gather information, conduct meetings, and work with producers one on one. This created challenges as land-grant universities developed programming using limited internal funding sources. For example, interest in industrial hemp

had shifted focus substantially by the time external funding was approved and available to university Extension programs. Research funding in a rapidly evolving new market also has challenges. The research question that was initially thought to be important needed to be overhauled as more information was made available by early adopters.

Collaboration between in-state and adjacent-state universities can be a valuable method to obtain information for producer groups and stakeholders that face a common set of problems. Caution must be exerted to ensure that the information provided applies to the producers or county where the Extension program occurs. Working collaboratively with other institutions allows Extension educators to share the burden of collecting information, analyzing data, and interpreting results. Collaborations also provide a secondary check for accuracy and consistency. For example, University of Tennessee and Kentucky worked collaboratively to provide information and decision aids to producers in Northern Tennessee and Southern Kentucky, regions that have similar production methods and are subject to the same supply chains and markets.

4.4 New Versus Existing Clientele—Balancing Starting Knowledge for Clientele

As previously mentioned, some value can be gleaned based on research and Extension programming from other commodities. However, delivering programming can be hampered based on a bimodal distribution of producers. Profit potential and blind optimism can attract existing agricultural producers and new potential producers to new or reemerging markets. The challenge in delivering impactful programming is that clientele start from different knowledge levels. For example, a producer with thirty years of agricultural production knowledge does not require clarity on common agricultural practice terms. At the same time, an individual new to agricultural production will need to have basic terms and processes defined before commodity and market-specific information can be disseminated. Many hemp meetings conducted in Tennessee were inundated with clarification questions that established producers found pedantic.

Another crossover of new markets and existing markets is risk. Successful and established producers understand and plan for risk. While most Extension programs have a risk education component, it is difficult to quantify risk exposure to established producers because of the uncertainty of new markets. Additionally, it is also difficult to educate beginning producers on the principle of risk when they don't have a fundamental understanding of agricultural production and market volatility. For example, most established crop producers have an understanding of how crop insurance works and what risks are mitigated. Thus, providing crop insurance Extension programing to experienced producers, can focus on the intricacies of hemp-specific crop insurance issues such as contracting, testing, and so on. A crop insurance program for new agricultural producers must first build a foundational crop insurance knowledge base before hemp-specific crop insurance information can be discussed.

5 Extension Program Delivery

One of the greatest challenges with developing Extension programs to meet the needs of stakeholders in new markets is the timeliness of delivery. In 2018 and 2019, producer and county-level requests for hemp programming were in high demand. However, this demand for programming generally occurred before research-based information was available. This led to Extension programming participants having questions unanswered or a feeling of limited value for the program attended.

5.1 Unexpected Challenges

Extension events also created challenges with private entities that were looking to capitalize on enthusiasm for the new market. For example, a 2018 University of Tennessee Extension program that was well advertised drew private companies to the location where unvetted product information was placed on program participants windshields and was passed out to producers in the parking lot. This

gave some producers the perception that the products and information passed out by the private company had been approved for distribution by the University of Tennessee, when it had not been authorized.

5.2 Delivery Methods and Timeliness

Extension programming for new markets can use numerous delivery methods to disseminate information to clientele. Social media provides county agents and specialists with the ability to advertise events and disseminate short form information to a large number of clients. Web-based meetings can be a viable tool to have participants from a larger geographic area. Pre-recorded videos can disseminate information to be viewed by producers at their leisure and also allows the educator to carefully articulate the information that they want to share, rather than being forced to respond to ad hoc questions from an in-person audience, which may result in spontaneous response that lacks nuance. Even with the use of technology, many producers still desire in-person programing. The two most common reasons, for preference, to in-person programing are interactions with others in the audience, that augments the formal program, thus building connections and a support network, and the capacity to interact with speakers outside of the formal program to have operation-specific questions answered and clarification provided.

6 Evaluating Program Results for New Programs

Obtaining program feedback and evaluation allows Extension educators to modify future programming, obtain additional resources, and convey research ideas to colleagues. Standard Likert program evaluations can provide valuable feedback to Extension educators; however, results need to be interpreted cautiously. For new industries, producer evaluations will typically reveal higher than normal increases in knowledge about the program but lower scores on the quality of the information. This is a function of limited available information. Additionally, as mentioned above, new markets attract many individuals that have not previously attended an Extension program. This can skew evaluation results if compared to other more established Extension programs.

As Extension educators, we are often asked to quantify impact. In new markets this can be challenging. With limited baseline information it is very difficult to quantify the financial impact of adoption of the information presented. Also, what is the impact of a potential producer attending a meeting and not proceeding to enter the market? In 2019 and 2020, many producers were thankful that they did not enter hemp production. Part of their decision was based on attending University of Tennessee and University Kentucky Extension programs that highlight the uncertainty in industrial hemp markets and risk management tools available. This poses the question of how should avoidance of a loss be quantified?

7 Discussion

Extension educators putting together new programs for markets or issues with limited information can follow a few rules of thumb: (1) be adaptive and flexible with timely information, (2) use multiple means of delivery, (3) collaborate with others to leverage more resources and information, and (4) evaluate results and apply recommendations to future programs.

Adapting programming to meet stakeholder needs as information evolves is essential when dealing with new markets. As such, the timeliness of programming is critical. This will involve initial programming with continuous updates as new information emerges. By effectively utilizing a web-based and in-person combination, programming can be more effective than exclusively utilizing one medium. Additionally, implementing a website or add in (drop down) to an Extension website will allow for information to be readily available for clientele and other Extension specialists. Information can be data, publication, video programming, or other items that could be useful.

Collaborating with other personnel that have different specialties is critical for early and sustained success. Future specialists should not be discouraged to ask for help when markets are emerging. Multidisciplinary collaboration can lead to increased funding, access to datasets, and increased awareness of the collaborators' Extension programs.

The steps laid out in program development also allow for new specialists and veteran specialists to work together. The implicit and explicit benefits of such collaborations can lead to retention of specialists for departments, tenure-track development, and future collaborations on other research topics.

8 Implications and Conclusions

Developing programs to address specific concerns or questions is essential for effective Extension programming. As highlighted earlier, emerging markets can create issues where there are more questions than unbiased research-based answers within the land-grant system. This can cause Extension programming to play catch up to the latest needs of the emerging market. Carbon and hemp markets highlight how programming needs can fluctuate based on changes in these emerging markets.

Lack of answers in Extension programming can cause individuals to turn toward other sources for information, especially with new clienteles. These new clienteles may turn away from Extension programming and seek answers from less reliable sources. Hemp and carbon markets are just two examples of how difficulties can arise. Policy and private interest will continue to drive new markets in the future. Future specialists must maintain the benefits of collaboration, obtaining grant funding, and program development to create and sustain a new program.

About the Authors: Charley C. Martinez is an Assistant Professor at the University of Tennessee (Corresponding Author: cmart113@utk.edu). S. Aaron Smith is an Associate Professor at the University of Tennessee. Tyler Mark is an Associate Professor at the University of Kentucky. Paul Goeringer is an Extension Specialist at the University of Maryland.

Acknowledgments: This work is supported by the Agriculture and Food Research Initiative (AFRI) program, Grant no. 2021-68008-33894/project accession no. 1025097, from the USDA National Institute of Food and Agriculture. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and should not be construed to represent any official USDA or U.S. Government determination or policy.

References

Campbell, B., T. Mark, B. McFadden, and A. Rabinowitz. 2021. "July 2021—Reporting Survey Data From February Through April." *Hemp Economic Marketing Research 2021*. Newark, Delaware. Available at: https://www.udel.edu/content/dam/udelImages/canr/pdfs/apec/hemp/Feb-AprUpdated.pdf

Cui, X., and S.A. Smith. 2020. "University of Tennessee Extension's 2020 Hemp Industry Survey." University of Tennessee Extension Publication W917. Knoxville, Tennessee. Available at: https://extension.tennessee.edu/publications/Documents/W917.pdf

Kolodinsky, J., and H. Lacasse. 2021. "Consumer Response to Hemp: A Case Study of Vermont Residents from 2019 to 2020." *GCB Bioenergy* 13(4):537–545.

Mark, T., and W. Snell. 2019. "Economic Issues and Perspectives for Industrial Hemp." In D.W. Williams, ed. *Industrial Hemp as a Modern Commodity Crop*. Madison WI: American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America, pp. 107–118.

Mark, T., J. Shepherd, D. Olson, W. Snell, S. Proper, and S. Thornsbury. 2020. "Economic Viability of Industrial Hemp in the United States: A Review of State Pilot Programs." United States Department of Agriculture, Washington D.C. Available at: https://ageconsearch.umn.edu/record/302486/

NBC-LEX18. 2019. "Kentucky Farmers Sue Hemp Company." October 21, 2019.

Nriagu, E. 2021. "EPA Carbon Credit." Retrieved from Center for Automotive Research. Ann Arbor, MI: https://www.cargroup.org/epa-carbon-credit/

Oleck, J. 2021. "A $65.5 Million Jury Verdict in Montana Reflects Industrial Hemp's Dramatic Fall in Value." Forbes.com. August 6, 2021.

Plastina, A. 2021. "How Do Data and Payments Flow Through Ag Carbon Programs?" Iowa State University Extension Publication Number A1-77. Ames,IA. Available at: https://www.extension.iastate.edu/agdm/crops/pdf/a1-77.pdf

Schneider, G. 2020. "Kentucky Hemp, CBD Giant's Bankruptcy Is a 'Black Eye' for Industry, Congressman Says." *Louisville Courier Journal*. February 6, 2020.

Shockley, J., and W. Snell. 2021. "Carbon Markets 101." Economic and Policy Update (21):4, Department of Agricultural Economics, University of Kentucky. Available at: https://agecon.ca.uky.edu/files/carbon_markets_101.pdf

U.S. Department of Agriculture. 2017. "2017 Census of Agriculture: State Profile Tennessee." National Agricultural Statistics Service, Washington DC. https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Tennessee/cp99047.pdf

U.S. Environmental Protection Agency. 2021. "Sources of Greenhouse Gas Emissions." *Inventory of U.S. Greenhouse Gas Emissions and Sinks Report*. Washington DC Available at: https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions

4(3) doi: 10.22004/ag.econ.323986