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Assessing Tennessee Livestock Producers' Awareness, Attitudes, and Perceptions of Right-of-Way Hay Harvesting

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Abstract

Tennessee Statute 54-5-134, Cutting Hay Along Controlled Access Highway Right-of-Way, provided agriculturalists the right to harvest hay along interstate highways' and other controlled access roads' medians and shoulders. Maintenance of these medians and shoulders are routinely contracted to private mowing companies and funded by Tennessee taxpayers. As a result of the Tennessee statute and lack of empirical information, a questionnaire was used to assess livestock producers' awareness, attitudes, and barriers concerning right-of-way hay harvesting. We found 7.2% of surveyed livestock producers were aware of their right to this resource, but none of the producers had applied for a permit. While livestock producers were highly innovative in terms of general agricultural practices, they were moderate in attitude towards right-of-way hay harvesting. Attributes leading to a more positive attitude toward right-of-way hay harvest were: (a) the ability to sell hay harvested from right-of-ways, (b) willing to pay someone else to cut hay from right-of-ways, and (c) currently purchasing hay. Alternatively, an attribute leading to a more negative attitude was currently feeding alfalfa mix hay. There is moderate interest among livestock producers to utilize hay from right-of-ways, but further research and education is needed to explore the practicality of this innovation.

Keywords: Right-of-way, hay, innovation, livestock

Kiers et al. (2008) professed agriculture is at a crossroad, and innovation is going to direct agriculture into the future success the world needs. Correspondingly, the American Association for Agricultural Education's 2016-2020 National Research Agenda underscored the importance of agricultural innovation and adoption and listed the study of new technologies, practices, and products adoption decisions as one of seven research priority areas (Roberts, Harder, & Brashears, 2016). According to Lindner, Rodriquez, Strong, Jones, and Layfield (2016), "additional research on and a better understanding of new technologies, practices, and products will help agricultural educators develop and implement agricultural teaching and learning processes contributing to the development of sustainable agricultural systems needed in the future" (p. 20). Linder et al. also

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professed this research requires agricultural education to have an outward focus on farmers and political and social systems.

With that in mind, efficient resource allocation is imperative among agriculturalists due to an impending population boom projected to be over 9 billion by 2050 (Food and Agriculture Organization of the United Nations [FAO], 2009). Impending challenges, brought on by new population growth, are unique to this generation, and these challenges are so complex and multifaceted that one solution will not solve the issue (Godfray et al., 2010). Historically, agricultural growth has always met and surpassed demands set by an ever-growing population, largely due to land acquisition and increased production from biological, chemical, and technological advances (Alexandratos & Bruinsma, 2012; Federico, 2005). However, due to various factors of urbanization, protected land, erosion, and nutrient depletion, "the amount of arable land available globally fell from 0.39 hectares per person in 1960 to 0.21 hectares in 2007" (Evans, 2010, p. 12). Therefore, instead of acquiring new farmland (Alexandratos & Bruinsma, 2012), agriculture will have to seize new innovations, technologies, and ideas to see the same success of previous generations (Federico, 2005).

Right-of-way hay harvesting may be part of the solution to increasing land use efficiency. Prior researchers have suggested instead of leaving roadside grass cuttings to mulch, the cuttings should be removed and used for purposes such as hay, compost, or biogas material (Cherney, Johnson, Petritz, & Sinha, 1990; Piepenschneider et al., 2016; Montgomeryshire Wildlife Trust [MWT], 2006). Cherney et al. (1990) determined hay harvesting from right-of-ways was feasible as long as location specific challenges were overcome. Furthermore, recruiting farmers to harvest the vegetation could be economically advantageous (Cherney et al., 1990) and potentially environmentally responsible with the removal of clippings (Parr & Way, 1988). In a report detailing the most beneficial vegetation management procedures, the Minnesota Department of Transportation (2008) stated haying right-of-ways contributes to a decrease in maintenance fees and is considered, in moderation, a "viable option" (p. 70).

Additionally, hay surpluses are vital to stable agricultural economics due to the impact of unforeseen events like drought (Coppock, 2011). Climate and weather events, such as drought, force agriculturalists to make decisions about livestock herd size in relation to water supply, grazing capacity, livestock sale rates, hay production, and breeding stock (Coppock, 2011). A multi-year drought study in Utah concluded practice and preparedness changed in cattle ranchers after droughts; ranchers became more proactive than reactive (Coppock, 2011). In Austin, Texas, where right-of-way hay harvest is permitted, livestock producers do not participate in right-of-way hay harvesting, because they are wary of the mixture of grass species found on right-of-ways (W. Rehnborg Texas Department of Transportation, personal communication, October 19, 2015). The majority of grass in Tennessee is tall fescue or tall fescue mixed with orchard grass or timothy (Bates, 1999). Cherney et al. (1990) found hay quality varied on right-of-ways; however, the lowest quality hay harvested from right-of-ways in their study was sufficient for mature beef cattle in accordance with standards set by the National Research Council (1984). To that end, Botterill and Mazur (2004) found risk perceptions are often over-exaggerated by the farming community, and this may be caused by farmers having a nature of being risk averse, which can often be attributed to many factors including lack of knowledge.

The state of Tennessee spends millions of dollars on right-of-way maintenance (State of Tennessee, 2016), but according to Tennessee Statute 54-5-134, C*utting Hay Along Controlled Access Highway Right-of-Way*, Tennessee farmers are able to petition to harvest hay off of right-of-ways. Permits are available for up to 3 miles or 50 acres of right-of-way vegetation (Tennessee Department of Transportation [TDOT], 2003). However, despite being legal, there is little evidence

Tennessee farmers are aware of their right to harvest hay on right-of-ways. Moreover, no studies were found which explored farmers' awareness, attitudes, or barriers regarding right-of-way hay harvesting. According to L. South (personal communication, February 12, 2015), an assistant general counsel in region two of TDOT, there has been one permit applied for to harvest hay on right-of-ways in the last six years. With pressures to increase efficiency and sustainability in agriculture and state resources, this study will seek to understand livestock producers' views of Tennessee Statute 54-5-134 and conduct economic impact analyses to determine producers' willingness to harvest hay from right-of-ways.

Theoretical Framework

Rogers' (2003) theory of diffusion of innovations served as the theoretical framework of this study. The adoption and utilization of a new idea or process is difficult to diffuse through a society, even if there are clear advantages (Rogers, 2003). Not every invention or new idea is readily accepted as a norm (Rogers, 2003). "Innovation is more than an invention. Success is not based on technological performance in isolation, but rather how [it] builds knowledge, networks and capacity" (Kiers et al., 2008, p. 321). Therefore, understanding how people respond to and accept innovation is the key to ensuring its speed in adoption and longevity in success (Rogers, 2003).

Diffusion researchers throughout the years have arrived at very similar steps, thus the innovation-decision process was developed (Rogers, 2003). The innovation-decision process outlines the essential steps to carry a potential adopter from initial knowledge to adoption or rejection of an innovation, and the process is composed of five stages that flow into each other – the completion of one step leads to the subsequent stage (Rogers, 2003). The stages are as follows: (a) knowledge, (b) persuasion, (c) decision, (d) implementation, and (e) confirmation (Rogers, 2003). With the aid of communication channels, an individual is able to transform into the next stage (Rogers, 2003). Duration of the innovation-decision process is dependent on the classification of the adopter and how quickly an individual adopts an innovation (Rogers, 2003). Rogers (2003) classified adopters as (a) innovators, (b) early adopters, (c) early majority, (d) late majority, and (e) laggards.

In order for one to persist through the innovation-decision process, an individual must acquire awareness or knowledge of an innovation (Rogers, 2003). The knowledge stage technically begins "when an individual (or other decision-making unit) is exposed to an innovation's existence and gains an understanding of how it functions" (Rogers, 2003, p. 171). Initial awareness may be a passive act, but typically, more detailed learning is active and is dependent on the following prior conditions: (a) previous practice, (b) felt needs/problems, (c) innovativeness, and (d) norms of the social systems (Rogers, 2003).

Following the acquisition of awareness and knowledge of an innovation, the adopter moves forward by developing either a positive or negative attitude during the persuasion stage (Rogers, 2003). An attitude, as defined by Rogers (2003), "is a relatively enduring organization of an individual's beliefs about an object that predisposes his or her actions" (p. 175). The information transforms from a purely cognitive state of the knowledge stage to being more active and affective, or a feeling (Rogers, 2003). Attitude development can be influenced by "(1) relative advantage, (2) compatibility, and (3) complexity" (Rogers, 2003, p. 175).

Once an attitude has been formulated based on advantages and disadvantages of the innovation in the potential adopter's viewpoint, the process continues onto an active decision stage (Rogers, 2003). As outlined by Rogers (2003), an individual may choose to adopt the innovation,

which is "a decision to make full use of an innovation as the best course of action available" (p. 177) or reject the innovation, which is "a decision not to adopt an innovation" (p. 177). Rejection of the innovation can occur at any point in the process as well in a passive manner, which could simply be exemplified by an individual forgetting that he or she heard of the innovation (Rogers, 2003).

After deciding to adopt the innovation, one moves to the implementation stage, which comes with the first active behavioral change as the innovation is put into actual use (Rogers, 2003). This stage varies in length depending on the innovation and if the adopter is an individual or if they are a group (Rogers, 2003). Re-invention, defined as "the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation" (Rogers, 2003, p. 180), can also occur in this stage. Re-invention is not considered a fault in the innovation, but could add difficulty to tracing the innovation as it diffuses through a population (Rogers, 2003). As for the adopter, re-invention of an innovation could allow the innovation to match individual needs better, thus leading to higher rates of adoption (Rogers, 2003).

Complete adoption of an innovation does not end at the implementation stage as there is an additional information-seeking period following implementation (Rogers, 2003). In the confirmation stage, an individual may seek "reinforcement for the innovation-decision already made, and may reverse this decision if exposed to conflicting messages about the innovation" (Rogers, 2003, p. 189). If an adopter experiences any sort of dissonance, they will seek to lessen or completely avoid it, thus discontinuing the innovation (Rogers, 2003).

Purpose and Objectives

The purpose of this study was to assess livestock producers' current awareness, attitudes, and barriers concerning right-of-way hay harvesting as well as to conduct economic impact analyses to determine producers' willingness to harvest hay from right-of-ways. The objectives of this study were:

1. Describe current awareness, need, and utilization of Tennessee Statute 54-5-134.
2. Describe perceptions of barriers to participating in right-of-way hay harvesting.
3. Determine if a significant difference exists in attitudes toward agricultural modernization and right-of-way hay harvesting.
4. Determine if there is a difference in the amount livestock producers are willing to spend versus the amount they are willing to pay someone to harvest right-of-way hay.
5. Determine factors impacting willingness to harvest right-of-way hay.

Methods

A quantitative research approach was used, and the research design was descriptive survey research, which was exploratory in nature due to limited information available on right-of-way hay harvesting. The target population for this study was livestock producers along Interstate 840 (I-840) in Tennessee. I-840, an interstate bypassing metropolitan Nashville, is accessible by five counties: (a) Hickman, (b) Dickson, (c) Williamson, (d) Rutherford, and (e) Wilson (Haslam & Schroer, 2012). The 77.28-mile bypass originally was designed in 1986 to alleviate Nashville traffic (Haslam & Schroer, 2012). Construction was completed in 2012 to connect I-840 to interchanges of I-40, I-65, and I-24 (Haslam & Schroer, 2012). To build the four lane bypass, 681 tracts of land were purchased, amounting to over 5,000 acres (Haslam & Schroer, 2012). According to TDOT's traffic history data set, there are sections of I-840 that receive less than 10,000 vehicles per day,

and the busiest sections of the road experience less than 45,000 vehicles a day (TDOT Applications, 2016).

A convenience sample was derived from a public listing of Tennessee Agriculture Enhancement Program (TAEP) recipients. Because the TAEP program is publically funded, the contact information of farmers receiving cost-share is public information. A list of all TAEP recipients from 2013-2015 was obtained using public records. The list provided a reliable bank of producers in the I-840 area. Five hundred twenty-nine livestock producers whose residency was listed in the aforementioned counties were selected and contacted based on Dillman, Smith, and Christian's (2014) tailored design method. Five contacts were used and the protocols varied based on the mode of contact (electronic or mail). TAEP recipients with email addresses were contacted electronically four times using the Qualtrics survey software. Non-respondents of the electronic survey were also contacted by mail. Mail respondents were sent a prenotice, the survey, and three reminders with additional surveys.

The livestock producers in this study agreed to participate by signing an electronic or paper informed consent approved by the University of Tennessee's Institutional Review Board. The survey took approximately 15 to 20 minutes to complete. Of the 529 TAEP recipients initially contacted, five members of the sample were recorded through correspondences as being deceased, which reduced the sampling frame to 524. Completed surveys were returned by 279 livestock producers or 53.2% of the sampling frame. Nonresponse was not addressed due to the sampling frame being a convenience frame. Therefore, readers should use caution when generalizing the results unless data confirms the sample of this study is representative of other populations of livestock producers.

Participants included 242 males and 31 females (six did not provide this data). The average age was 57.7 years old, and 96.4% described their ethnicity as white, 1.4% as black or African-American, 0.4% as Native American or American Indian, and 1.8% did not prefer to answer. One hundred of 277 who described their farming employment status indicated they were full-time farmers, and 272 provided their highest level of education: 2.2% some high school, 23.9% high school, 9.2% trade or technical or vocational training, 19.5% some college, 27.2% bachelor's degree, 10.7% master's degree, and 7.4% PhD. A majority were 15 miles or less from an I-840 access point with 0 – 5 miles, 5.1 – 10 miles, 10.1 – 15 miles, 15.1 – 20 miles, and 20.1 or more miles being 19.8%, 24.1%, 18.7%, 14.7%, and 22.7%, respectively.

The questionnaire utilized for data collection was the *Right-of-Way Innovation Questionnaire* and was developed by the researchers using guidelines proposed by the tailored design method (Dillman et al., 2014). The questionnaire consisted of 12 demographic items, an 8 item *Agricultural Modernization* scale, 27 items to assess hay use and current practices, 5 items to assess knowledge of Tennessee Statute 54-5-134, a 7 item *Attitudes Toward Right-of-Way Hay Harvesting* scale, 1 open-ended and 17 close-ended items to assess barriers of right-of-way hay harvesting and 10 items related to the economics of hay harvesting.

The *Agricultural Modernization* scale was adapted from Knight, Weir, and Woldehanna's (2003) *Attitudes Toward Modernization* scale. Because Knight et al.'s scale focused on crop production as opposed to overall general agriculture and to update item wording to a present day translation, slight wording changes were made to five of the eight items. For example, *I like to try new crops* was changed to *I like to try new things in agriculture* and *The way my father farmed is still the best way* was changed to *The way the previous generation farmed is still the best way*.

Furthermore, the *Attitudes Toward Right-of-Way Hay Harvesting* scale was developed by modifying the *Agricultural Modernization* scale. One item was eliminated from the *Agricultural Modernization* scale because of the specificity of the scale to right-of-way hay harvesting. The remaining 7 items were modified to include right-of-way hay harvesting in each item. For example, *I want to try new farming techniques* was changed to *I am interested in trying right-of-way hay harvesting* and *I want to see new techniques tried first by others* was changed to *I want to see right-of-way hay harvest tried first by others*. The *Agricultural Modernization* and *Attitudes Toward Right-of-Way Hay Harvesting* scales used the following 5-point rating scale: 1 = *strongly disagree*, 2 = *disagree*, 3 = *neither agree nor disagree*, 4 = *agree*, 5 = *strongly agree*. Also, based on precedence set by previous researchers (Enochs, Smith, & Huinker, 2000; Haynes & Stripling, 2014), livestock producers' *Agricultural Modernization* and *Attitudes Toward Right-of-Way Hay Harvesting* scores were categorized as low (1.00 to 2.33), moderate (2.34 to 3.67), and high innovation (3.68 to 5).

The 27 hay use and current practices items were adapted from Penton Research's (2015) beef forage study, and the barrier items were developed using the current literature. The questionnaire also contained a knowledge prompt regarding the Tennessee Statute 54-5-134, which was developed by the researchers. In 17 close-ended questions, producers were surveyed regarding their perceptions of possible barriers to participating in right-of-way hay harvesting. Producers were asked to describe their perceptions towards the list of possible barriers according to a 5-point scale (1 = *strongly disagree*, 2 = *disagree*, 3= *neither agree nor disagree*, 4 = *agree*, 5 = *strongly agree*).

As suggested by Dillman et al. (2014), a preliminary questionnaire review was conducted by an expert panel consisting of an assistant professor of agricultural and resource economics, a TDOT lawyer, and an assistant professor of agricultural leadership, education and communications. The expert panel reviewed the questionnaire for face validity, wording, and structure. Cognitive interviews were also conducted with five TAEP recipients from counties not included in this study. Dillman et al. (2014) recommends conducting cognitive interviews to ensure that "respondents comprehend questions as intended by the survey sponsor and whether questions can be answered accurately" (p. 244). Information from the interviews led to the following revisions: (a) rewording two items to improve clarity, (b) a gray background was added to the skip logic wording, and the words were bolded to make the skip logic more apparent on the paper survey, and (c) the informed consent agreement or disagreement statements were bolded and underlined on the paper survey to make them more apparent.

After making these revisions, a sample of 38 TAEP recipients from Maury County was selected to take part in a pilot test. For the pilot test, one modification was made to the questionnaire. A suggestion/comment item was placed at the end of the survey to elicit questionnaire feedback. Based on the feedback, one spelling error was corrected. Internal-consistency was assessed for the two scales using Cronbach's alpha. The pilot test reliabilities for the *Agricultural Modernization* and *Attitudes Toward Right-of-Way Hay Harvesting* scales were found to be .70 and .81 respectively.

Descriptive statistics were used to summarize demographics, hay use and current practices, knowledge of Tennessee Statute 54-5-134, barriers of right-of-way hay harvesting, and economics of hay harvesting. A summated mean was calculated for the *Agricultural Modernization* scale after reverse coding items 1, 3, 5, and 7. Additionally, a summated mean was calculated for the *Attitudes Toward Right-of-Way Hay Harvesting* scale after reverse coding items 1, 3, 5, and 6. Paired t-tests were utilized to determine if significant differences existed among *Agricultural Modernization* and *Attitudes Toward Right-of-Way Hay Harvesting* scores in addition to the amount livestock

producers are willing to spend to harvest right-of way hay versus the amount they are willing to pay someone to harvest right-of-way hay. Effect sizes were calculated for statistically significant results using Dunlap, Cortina, Vaslow, and Burke's (1996) formula for Cohen's *d* to correct for overestimation due to the correlation between measures. Finally, a stepwise regression was used to determine factors impacting willingness to harvest right-of-way hay as measured by the *Attitudes Toward Right-of-Way Hay Harvesting* scale.

Results

Current Awareness, Need, and Utilization of Tennessee Statute 54-5-134

In an inventory analysis of livestock owned by the livestock producers, beef cattle accounted for 86.4% of all animals, with 19,647 head, and dairy cattle were 844 head or 3.7% of all livestock. Goats and sheep were 788 and 770 head respectively, which is 3.5% and 3.4% of the inventory. Equine accounted for 1.6% with 362 head, and 318 head of other livestock were reported, which was 1.4% of the inventory.

As shown in Table 1, 18 or 7.2% of the livestock producers were aware of the statute providing the right to harvest hay from Tennessee right-of-ways prior to the questionnaire. Four of those 18 livestock producers indicated they learned of Tennessee Statute 54-5-134 from the University of Tennessee Extension service. None of the livestock producers who participated in this study had applied, received, or utilized a permit to harvest right-of-way hay.

Table 1

Livestock Producers' Awareness of Tennessee Statute 54-5-134

Item	*f*	%
Aware of Tennessee Statute 54-5-134?		
Yes	18	7.2
No	233	92.8
Learned from University of Tennessee Extension?		
Yes	4	25.0
No	12	75.0
Applied for permit?		
Yes	0	0.0
No	16	100.0

As shown in Table 2, 99.2% of the livestock producers utilized hay for feed, and 67.7% of the livestock producers who harvested hay in 2015 experienced a surplus. In 2015, the livestock producers harvested 76.5% of the total hay utilized (see Table 3). These hay resources were primarily harvested from owned land, leased land, and non-leased land with owner's permission. Furthermore, the livestock producers reported fescue (42.2%) and mixed grass (47.6%) as their top two types of hay harvested. The remaining 23.5% of hay utilized was purchased.

Table 2

Livestock Producers' Hay Use and Supply in 2015

Items	*f*	%
Do you use hay to feed livestock?		
Yes	250	99.2
No	2	0.8
If you harvested hay in 2015, did you harvest a surplus of hay?		
Yes	149	67.7
No	71	32.3

Table 3

Livestock Producers' 2015 Hay Harvesting Methods and Forage Species

Items	%
Method of hay harvest	
I cut hay off my own land	42.4
I cut hay off of leased land	20.6
I pay someone to cut hay off my own land	6.0
I pay someone to cut hay off of leased land	2.8
I purchase my hay	23.5
I cut hay off non-leased land with owner permission.	14.2
Other	0.2
Species of hay utilized	
Fescue	42.2
Alfalfa	1.8
Alfalfa mix	0.3
Bermuda	2.7
Bermuda mix	1.6
Grass mix	47.6
Other	6.9

Perceptions of Barriers to Participating in Right-of-Way Hay Harvesting

As displayed in Table 4, the majority of livestock producers indicated barriers to participating in right-of-way hay harvest including: (a) low quality hay, (b) roadside debris and litter, (c) contaminated with chemicals and metals, (d) hay transport, (e) the need for insurance and performance bond, (f) meeting deadlines set by governmental officials, (g) meeting deadlines set by current right-of-way contractors, (h) communicating with current right-of-way contractors, (i) having to plan around contracted litter removals, (j) slopes, (k) traffic and (l) narrow shoulders and medians on I-840. The highest ranked items, *roadside debris and litter* and *traffic*, received 85.1% and 80.0% agreeance, respectively. Of the remaining items, *mixed species hay* and *cannot legally sell hay* were the least concerning barriers to livestock producers with 28.4% and 28.0% disagreement respectively.

Table 4

Livestock Producers' Perceptions of Possible Barriers to Utilization of Their Rights According to Tennessee Statute 54-5-134

	Disagree		Neither agree nor disagree		Agree	
Items	*f*	%	*f*	%	*f*	%
Roadside debris and litter	13	5.4	23	9.5	206	85.1
Traffic	14	5.7	35	14.2	197	80.0
Slopes	15	6.1	45	18.4	184	75.4
Contaminated with chemicals and metals	19	7.8	57	23.4	168	68.8
Narrow shoulders and medians on I-840	18	7.3	61	24.8	137	67.8
Hay transport	33	13.5	52	21.3	159	65.1
Meeting deadlines set by government officials	22	8.9	64	26.1	159	64.9
Meeting deadlines set by current right-of-way contactors	22	8.9	70	28.6	153	62.5
Having to plan around contracted litter removals	25	10.0	67	27.3	153	62.4
Low quality hay	32	13.1	67	27.5	145	59.4
The need for insurance and performance bond	43	17.6	63	25.7	139	56.7
Communicating with current right-of-way contactors	28	11.5	89	36.3	128	52.2
Communicating with government officials	37	15.1	91	37.1	117	47.8
Strict rules	42	17.2	109	44.5	94	38.4
Mixed species hay	67	28.4	99	41.9	70	29.7
Optional hay testing fees	53	21.6	120	49.0	72	29.4
Cannot legally sell hay	68	28.0	114	46.9	61	25.1

Attitudes Toward Agricultural Modernization and Right-of-Way Hay Harvesting

The summated mean of the *Agricultural Modernization* scale was 3.71 (*SD* = 0.42), which corresponds to high innovation. Examining attitudes toward agricultural innovation further revealed 51.5% of the livestock producers possessed high innovative attitudes toward agriculture, and 48.5% possessed moderate innovation attitudes toward agriculture. None of the livestock producers possessed low innovation attitudes toward agriculture (See Table 5).

The summated mean for the *Attitudes Toward Right-of-Way Hay Harvesting* scale was 2.99 (*SD* = 0.63), which corresponds to moderate innovation. As shown in Table 6, 12.4% of the livestock producers held a high innovation attitude, 75.9% held a moderate innovation attitude, and 11.7% held a low innovation attitude toward right-of-way hay harvesting.

Table 5

Livestock Producers' Agriculture and Right-of-Way Innovation Classifications

			Low		Moderate		High	
Scale	*M*	*SD*	*f*	%	*f*	%	*f*	%
Attitudes toward agricultural modernization	3.71	0.42	0	0.0	126	48.5	134	51.5
Attitudes toward right-of-way hay harvesting	2.99	0.63	29	11.7	189	75.9	31	12.4

Note. 1.00 to 2.33 = low innovation, 2.34 to 3.67 = moderate innovation, 3.68 to 5 = high innovation.

Furthermore, the *Agricultural Modernization* summated mean was 0.73 (*SD* = .64) greater than the *Attitudes Toward Right-of-Way Hay Harvesting* summated mean, and the difference was statistically significant ($p < .05$; Table 6). The practical significance of the difference was assessed using Cohen's *d*, and the effect size was 1.35, which is a large effect size (Kotrlik, Williams, & Jabor, 2011). Thus, livestock producers were substantially more innovative in general agricultural practices as compared to right-of-way hay harvesting.

Table 6

Change in Perceived Innovativeness According to Livestock Producers' Agriculture and Right-of-Way Innovation Classifications

	Mean difference	*SD*	*SE*	*t*	*p*	*d*
Innovativeness posttest - pretest	-0.73	.64	.04	-18.14	.00	1.35

Produced and Contracted Harvesting of Right-of-Way Hay

Two hundred eleven (88.7%) livestock producers indicated they were not interested in paying to cut right-of-way hay (see Table 7). The remaining 11.3% indicated they would pay to harvest right-of-way hay. Also, 7.9% of the livestock producers were willing to pay $1-10/acre, and 3.3% were willing to pay more than $10/acre to harvest right-of-way hay.

Table 7

Amount Producers Are Willing to Pay to Harvest One Acre of Right-of-Way Hay

Response	*f*	%
Nothing	211	88.7
$1-5	12	5.0
$6-10	7	2.9
$11-15	2	0.8
$16-20	3	1.3
$21-25	1	0.4
$26-30	1	0.4
$31 or more	1	0.4

Additionally, 169 (74.1%) livestock producers indicated they were not interested in paying someone else to cut right-of-way hay for their own use (see Table 8). The remaining 25.9% indicated they would pay someone else to harvest right-of-way hay. Also, 17.5% of the livestock producers were willing to pay someone more than $10/acre to harvest right-of-way hay.

Table 8

Amount Producers Are Willing to Pay Someone to Harvest One Acre of Right-of-Way Hay

Response	*f*	%
Nothing	169	74.1
$1-5	11	4.8
$6-10	8	3.5
$11-15	10	4.4
$16-20	11	4.8
$21-25	6	2.6
$26-30	7	3.1
$31 or more	6	2.6

As shown in Table 9, a significant difference was not found in regard to the amount livestock producers are willing to pay versus the amount they are willing to pay someone to harvest right-of-way hay. To that end, the mean difference was \$6.00/acre (SD = 13.39, p > .05).

Table 9

Difference in Willingness to Pay to Harvest Versus Pay Someone to Harvest Right-of-Way Hay

	Mean difference	*SD*	*SE*	*T*	*p*
Price willing to spend to harvest right-of way – Price willing to pay someone to harvest right of way hay	-\$6.00/acre	13.39	3.46	-1.74	.10

Factors Impacting Willingness to Harvest Right-of-Way Hay

Stepwise multiple regression was used to determine factors impacting willingness to harvest right-of-way hay as measured by the *Attitudes Toward Right-of-Way Hay Harvesting* scale. Four variables, shown in Table 10, explained 29.6% of the variance in harvest attitude. Livestock producers willing to cut hay off of right-of-ways if they could sell it, had a mean score 0.47 points higher than the mean of those respondents who were not interested in cutting hay off of right-of-ways. Using an alfalfa mix hay resulted in a decline in the mean score of 1.27 points. A producer's score increased 0.06 points per \$5/acre increment for those willing to pay someone else to cut right-of-way for hay. Finally, producers who purchased their hay showed a 0.24 increase in their summated mean of the *Attitudes Toward Right-of-Way Hay Harvesting* scale.

Table 10

Summary of Stepwise Regression for Variables Impacting Right-of-Way Hay Harvesting Attitude

Variable	*B*	*SE B*	*p*
Willingness to cut hay off right-of-way if it can be sold	0.47	0.10	.000
Alfalfa mix hay users	-1.27	0.45	.006
Willingness to pay someone else to cut hay off right-of-way	0.06	0.02	.017
Producers that purchase their hay	0.24	0.11	.032

Note. Full Model: R^2 = 0.319*; Adjusted* R^2 = .0.296

Discussions and Recommendations

Most livestock producers did not have prior knowledge of their right to harvest right-of-way hay. According to Rogers (2003), knowledge is the first step in adopting an innovation. Without knowledge, an attitude towards an innovation cannot be made (Rogers, 2003). Because producers were learning of the innovation via this study, they had little time to process the law and

develop more than an initial attitude. Sahin (2006) concluded from a review of innovation in educational technology that "uncertainty about the innovation's functioning… affect[s] the individual's opinions and beliefs about the innovation" (p. 16). Because producers lacked the ability to process the law in terms of the outlined steps of the persuasion stage, (a) relative advantage, (b) compatibility, (c) complexity, (d) trialability, and (e) observability, development of an attitude was shallow (Rogers, 2003), and as a result, impacted this study.

The need for hay is evident according to data collected from livestock producers. Despite having normal rainfall through the 2015 hay harvesting months, except for a window from May 12th–26th in which rainfall was abnormally dry (National Drought Mitigation Center, 2015), 32.3% who harvested their hay, as opposed to purchasing it, did not have a surplus. The term *selective perception,* which is "the tendency to interpret communication messages in terms of the individual's existing attitudes and beliefs" (Rogers, 2003, p. 171), described the importance of need in the innovation-decision process. Thus, the producers that did not obtain a surplus of hay in 2015 may be more apt to pursue information concerning the innovation (Rogers, 2003).

Also, hay surpluses are vital to stable agricultural economics due to the impact from unforeseen drought, and hay storage is an option for reducing the effects of drought (Coppock, 2011). In the 2010-2011 TAEP year, 37.9% of the $14,184,693 budget was utilized on hay storage facilities for producers, so there is capacity for hay store among this population of producers. While 2015 was a good rain year, a drought may change attitudes and encourage higher acceptance of right-of-way haying and storage. Coppock (2011) found cattle ranchers in Utah changed practice and preparedness after drought.

Furthermore, data showed the hay utilized by our sample in 2015 was 89.8% fescue or grass mix. This is interesting given livestock producers in the Austin, Texas area, where similar laws exist pertaining to the right to right-of-way hay harvest (W. Rehnborg, Texas Department of Transportation, personal communication, October 19, 2015), do not participate in right-of-way hay harvesting because they are wary of the mixture of species of grasses growing on right-of-ways. According to Bates (1999), the majority of grass in Tennessee is tall fescue or tall fescue mixed with orchard grass or timothy. Livestock producers' current practice of cutting hay and feeding mixed grass hay may be conducive to right-of-way hay harvest adoption.

In 2015, of the hay acquired by livestock producers, 37.6% was derived from land they did not own – (a) *I cut hay off of leased land*, (b) *I pay someone to cut hay off of leased land*, and (c) *I cut hay off non-leased land with owner permission*. Because the right-of-way harvest permits are structured similarly to leased land (TDOT, 2003), the common utilization of leased land and non-leased land agreements are important to consider. If farmers are already utilizing leased or borrowed land as an agricultural practice (Rogers, 2003), they may be more likely to adopt right-of-way hay harvesting once they are made aware of Tennessee Statute 54-5-134.

None of the livestock producers in this study had ever utilized their right to harvest hay from state right-of-ways. This finding is consistent with the researchers' conversation with L. South (personal communication, October 13, 2015) of TDOT who had only one remembrance of anyone applying for a permit in his region. While rejection of the right-of-way hay harvesting innovation is one plausible explanation as to why livestock producers do not apply for right-of-way hay harvesting permits, Rogers' (2003) diffusion of innovation theory suggests the absence of knowledge of Tennessee Statute 54-5-134 as another plausible explanation.

In regard to barriers to participating in right-of-way hay harvesting, the item *roadside debris and litter* earned the highest rank among all perceived barriers. TDOT also has concerns

regarding roadway liter. According to TDOT (2016), "excessive litter can become a road hazard and litter can present a danger when mowing right-of-way" (p.12). In 2015, the state of Tennessee appropriated $316,800 for litter cleanup in the five counties represented in this study (TDOT, 2016). As a result of Tennessee's initiatives to clean up their roadways through cleanup and educational efforts, there have been consistent declines in the amount of litter on roadways (TDOT, 2016). By working to eliminate right-of-way litter, there is the potential to eliminate or greatly reduce the litter barrier for livestock producers. Furthermore, TDOT officials and livestock producers may be able to work together to align litter removal with hay harvesting to ensure that less litter ends up in right-of-way harvested hay.

Livestock producers in this study also indicated *low quality hay* was a potential barrier. This was a predicted deterrent by W. Rehnborg (personal communication, October 13, 2015) and Cherney et al. (1990). However, Cherney et al. found the lowest quality hay harvested from right-of-ways in their study was sufficient for mature beef cattle in accordance with standards set by the National Research Council (1984). Beef cattle were the most prevalent species of livestock owned by Tennessee livestock producers in this study. Because beef cattle operations are so commonplace in the region surveyed, hay quality may be high enough for these operations.

One of the least deterring items to adoption of right-of-way hay harvesting was *mixed species hay*. This finding stands in opposition to W. Rehnborg (personal communication, October 13, 2015) and Cherney et al. (1990) who professed livestock producers would not be accepting of hay that contained several varieties of grasses. As previously stated, when considering current agricultural practices by livestock producers in Tennessee, producers are already utilizing mixed species hay, and this practice may aid in the diffusion of right-of-way hay.

Overall, livestock producers possessed high innovation in agricultural practices. Therefore, livestock producers in this study appear to be willing to adopt new agricultural practices and technology. According to Rogers (2003), innovativeness is a prior condition required of a potential adopter of an innovation (Rogers, 2003). Innovation is vital to agriculture in the upcoming decades as the adoption of new techniques and practice have been called upon to meet new satiety demands of a growing population (Kiers et al., 2008).

When attitudes were collected post-knowledge prompt concerning the specific right-of-way hay harvest innovation, livestock producers possessed moderate attitudes of the innovation. Attitude can influence the risk factors associated with an innovation in farmers (Botterill & Mazur, 2004). Botterill and Mazur (2004) found farmers' risk perceptions are often over-exaggerated and may be caused by having a nature of being risk averse, which can be partially attributed to a lack of knowledge (Botterill & Mazur, 2004). Since the livestock producers were unaware of their right to harvest right-of-way hay prior to this study and sometimes exaggerate risk, this may explain why attitudes towards right-of-way hay were moderate and not consistent with attitude toward general agricultural practices.

In addition, a significant difference existed between the livestock producers' attitude toward agricultural innovation and the specific innovation of right-of-way hay harvesting. Innovativeness of the livestock producers fell significantly from high to moderate when questioned specifically in regards to the right-of-way hay innovation. Therefore, at the time of this study, livestock producers held a more negative attitude towards the right-of-way hay harvest innovation. Rogers (2003) stated that it is assumed that attitude will lead to action, but typically in practice, a discrepancy exists between attitude and practice. In addition, circumstance may play a large factor in moving to action (Rogers, 2003). For instance, a producer may have a moderate attitude during rainy years, but drought in the future may force them to reconsider attitudes they have developed.

With that in mind, there are many factors that lead to adoption of an innovation (Rogers, 2003), thus, current hay growing conditions, lack of knowledge, and the aforementioned barriers may partially account for the difference in attitude.

In regard to paying someone else to cut and harvest hay off state right-of-ways, over a quarter of producers indicated they would be willing to do so, and 17.5% would be willing to pay over $10 an acre. This may indicate hay quality and yield are not factors discouraging these producers from adopting the practice of using right-of-way hay. Nothing in the most recent version of rules for Tennessee Statute 54-5-134 specifies that the permit holder has to be the one to physically collect hay (TDOT, 2003). If producers are willing to permit the land and contract the work, then there may be viability in pursuing the dissemination of information about the law. Also, producers may be willing to purchase right-of-way hay from the state or state contractors.

Statistically, there was no difference found between the amount a livestock producer was willing to pay to harvest hay on state right-of-ways, and the amount a producer would pay to have someone else harvest the hay for them. This may indicate that the value of right-of-way hay is found in having access to right-of-way hay and is not necessarily influenced by the method of harvesting the hay. Because the mean difference of $6/acre was not significant, one can conclude the amount livestock producers were willing to pay for right-of-way hay did not differ in terms of who was harvesting the hay.

Lastly, four variables were identified that accounted for 29.6% of the variance in *Attitudes Toward Right-of-Way Hay Harvesting* scores. Attributes leading to a more positive attitude toward right-of-way hay harvest were: (a) the ability to sell hay harvested from right-of-ways, (b) willing to pay someone else to cut hay off right-of-ways, and (c) currently purchasing hay. Alternatively, an attribute leading to a more negative attitude was currently feeding alfalfa mix hay. Investigating the effect of changing Tennessee law to allow the sale of right-of-way hay and allowing livestock producers to pay someone else to harvest the right-of-way hay may be of interest, since the opportunity to sell and willingness to pay someone else to harvest the hay resulted in more favorable attitudes toward right-of-way harvesting. Furthermore, livestock producers who buy their hay supply may see Tennessee Statute 54-5-134 as a way to reduce their hay cost. On the other hand, livestock producers feeding alfalfa mix hay may possess less favorable attitudes due to alfalfa mix hay being a higher quality forage than other grass mixes, which are generally found in Tennessee grasslands (Bates, 1999). The effects the factors above had on attitude supports Rogers (2003). Rogers stated previous practice related to an introduced innovation influences adoption. In this case, if livestock producers were allowed to purchase, sell, or pay someone else to harvest right-of-way, they may be more likely to harvest or support right-of-way hay harvesting and less likely to do so if they feed alfalfa mix or higher quality hay.

Recommendations for Future Research

Based on our findings, the following recommendations for future research are made:

1. Due to the limited scope of this study, replication should be done statewide to accumulate more data on economic conditions and livestock producers' current awareness, attitudes, and barriers in relation to right-of-way hay harvesting.
2. Future research should further explore factors that impact adoption of right-of-way hay.
3. Since most producers were not aware of Tennessee Statute 54-5-134, future research is warranted on the effects of educational programming and promotion of the law. Would attitudes toward right-of-way hay harvesting differ after educational programming or promotion? Most producers in this study became aware of Tennessee Statute 54-5-134 by

participating in the study and had only minutes to develop attitudes toward harvesting right-of-way hay. Will increased awareness result in more permits issued?
4. Future research should investigate the actual risk and impact of perceived barriers to right-of-way hay harvesting.
5. Because there was interest among livestock producers to sell right-of-way hay, as well as livestock producers interested in buying right-of-way hay, future research should investigate the feasibility of accommodating these interests.
6. Future research should determine if livestock producers are willing to purchase right-of-way hay from the state of Tennessee or state contractors.
7. Research is warranted to determine the nutritional quality of right-of-way hay.

Recommendations for Practice

Based on our findings, the following recommendations are made:

1. Livestock producers should be made aware of Tennessee Statute 54-5-134. Extension professionals in Tennessee can serve as a source of information, and Extension communication channels can be used to share information regarding Tennessee Statute 54-5-134. For example, livestock producers can be made aware of Tennessee Statute 54-5-134 during master beef and goat programming, and Tennessee Statute 54-5-134 can be discussed in Extension bulletins/fact sheets. Furthermore, the University of Tennessee and Tennessee State University Extension, private industry representatives, and other agricultural educators should utilize this study to develop educational programs in conjunction with TDOT officials to further educate livestock producers across the state of their rights.
2. Livestock producers that exhibit the factors determined to produce more favorable attitudes toward right-of-way hay harvesting should be targeted with information related to Tennessee Statute 54-5-134.
3. Perceived barriers may become lessened with education. Future practice should focus on educating interested livestock producers on how to minimize barriers related to right-of-way hay harvesting.
4. The state of Tennessee should continue efforts to reduce litter on right-of-ways; reduced liter may encourage livestock producers to obtain permits.
5. Because there was interest among livestock producers to sell right-of-way hay, as well as livestock producers interested in purchasing right-of-way hay, the state of Tennessee should explore allowing permit holders to sell hay to livestock producers.

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