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Impact of an Educational Program on a Year-Round Forage Production and Grazing Management System in Alabama

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IMPACT OF AN EDUCATIONAL PROGRAM ON A YEAR-ROUND FORAGE PRODUCTION AND GRAZING MANAGEMENT SYSTEM IN ALABAMA

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Abstract

Raising animals on supplementary feeds in the lean months is economically unfeasible due to the increasingly high price of grains and commercial feeds. The objective of this study was to estimate the economic impact of educational events on year-round pasture and grazing management. A survey was introduced through SurveyMonkey to 78 trainees to collect data on a pre-structured questionnaire. A conceptual framework of production function was applied to measure the impact of the events using a before vs. after impact assessment approach. Forty-six percent of respondents completed the survey. The results revealed that the educational events had a positive impact on the cultivation of cool and warm season grasses and legumes, rotational grazing, technology adoption, multiplication of acquired knowledge and skills, changes in attitude and behavior, and household income. Reaching out to small-scale livestock farmers with need-based technological support helps them in sustaining their farms.

Keywords: Educational Programs, Capacity Building, Year-Round Forage Production, Grazing Management

Introduction

Raising livestock in Alabama is a significant challenge for small and limited resource farmers because of shortage of green forages for seven lean months (September/October–March/April). Producers have to spend more money on supplementary feedstuffs, such as agricultural byproducts, commercial feeds/grains, and hay, to sustain their animals. However, raising animals on supplementary feeds is economically unfeasible for the small-scale, limited resource livestock producers. Gillespie et al. (2012) argued that feed is the most expensive operating cost (about 70% of the total variable cost) for raising animals. Therefore, growing enough forages, improving pastures, and grazing systems would reduce the increasing feed cost. Similarly, Bossis (2012) highlighted the importance of using pastures to reduce the requirement for concentrate feed, thereby minimizing the feeding costs of goats. In addition, producers have to perform more tasks with the concentrate feeding such as (i) developing and maintaining storage facilities, (ii) working extra hours to feed animals, and (iii) dealing with storage and feeding loss of feedstuffs.

The return from goats and sheep production often results in negligible to no profit despite the hard work of the producers (Karki, 2013) if supplemented with concentrates during the lean months. A forage-based production underpins sustainable production systems, which is considered to be a good agricultural practice. Kumar (2007) explained that expenditure on feed and fodder was the major component of the cost of goat rearing on commercial farms, and found that it accounted for 59% of the total variable cost. The author further explained that the concentrate feed accounted for 58% of the total cost, and dry fodder accounted for 25% of the total feed cost. Therefore, it is far-sighted on the part of the farmers to practice a low-cost feeding approach to enhance profitability. According to Coffey (2006), to raise goats at a low cost, the producer must maximize the use of forages. The author maintained that establishing good pasture might reduce winter feeding cost by

38% (supplementary feed cost 25% and hay cost 13%). Kieser (2008) stated that if roughages (green/dry forages) do not contain or supply the required nutrients, animals should be given some commercial feed supplement, which is much more expensive than hay. The author indicated that hay and grain mix comprise, respectively, 18% and 22% of the 40% total feed cost.

The necessary condition for the forage-based livestock production requires green forages – pastures available year-round, including both cool and warm season grasses and legumes. Luginbuhl (2006) stated that cool-season perennial and annual grasses are generally of higher quality than warm season grasses (longer productive season, provide very high-quality forage for grazing when warm season grasses are dormant). It is of utmost importance to make farmers, especially small-scale, limited resource, aware of the importance and scope of the forage-based livestock production system and its implications on the household economy.

The existing problem of the livestock producers (in Alabama) is the availability of green forages only during five months in a year (May/June-September/October). The crucial time for raising livestock is the lean seven months of the year, when there is a high scarcity of green forages. During this period, farmers have to spend a significant amount of money to procure enough hay and concentrate or at least other feedstuffs to compensate for the low amount of nutrients available from the dry forages. It triggers an exponential increase in the feeding cost, which is usually unaffordable for small and limited resource farmers. Overall, the quantity and quality of animal feeds have a direct impact on the composition and quality of livestock products.

In addition to the scarcity of forages, many small-scale livestock producers and forestland owners in the Southern Region do not fully use their land resources. The land is abandoned, unattended to, barren, or not used for economic benefit, mainly because they do not have the requisite knowledge and skills to make the best economic use of the available land. Therefore, the objective of this study was to assess the impact of an educational program on a year-round forage production and grazing management system in Alabama. Educating target audiences is the only possible approach to strengthen their holistic knowledge and skills about the sustainable forage-based animal production systems and marketing to make the enterprise(s) economically viable.

Literature Review

As mentioned earlier, the single, most-expensive variable cost in any livestock operation (including goats) is feed. For example, Solaiman (2006) indicated that about 64% of the total variable cost (Solaiman, 2006). According to Al-Khaza'leh et al. (2015), feed was the highest cost factor accounting for 75% of the total variable costs of raising goats. Similar findings were reported by Eftimova et al. (2014) with feed costs accounting for 44%-49% of the total production costs. Singh et al. (2014) mentioned that 63% of the total operating cost of raising goats was for feed. Growing enough forages and proper feeding and management can significantly reduce production costs, by minimizing the requirements for purchased feed. To reduce the feeding cost, Luginbuhl (2016) emphasized the development of a year-round grazing system for goats. Goats raised for meat need high-quality feed in most situations and require an optimum balance of many different nutrients to achieve maximum profit potential. Because of their unique physiology, meat goats do not fatten like cattle or sheep, and rates of weight gain are smaller, ranging from 0.1 to 0.8 pounds per day Luginbuhl (2016). Therefore, profitable meat goat production can only be achieved by optimizing the use of high-quality forage and browse and the strategic use of expensive concentrate feeds only when it is absolutely needed.

Profit margin through livestock enterprise can be increased by developing a year-round forage/pasture and grazing improvement program allowing animals for as much grazing as possible throughout the year (Luginbuhl, 2006). In line with the forage-based production, Wong et al. (2008) stated that grass-fed dairy cattle remain on the pasture their entire lives and are allowed to roam freely. They eat a natural diet, making them strong and healthy; therefore, they have no need for antibiotics and hormones like cows in conventional dairies. They grow naturally and produce wholesome and natural products. Beef cattle production systems based on perennial pastures are potentially more sustainable than those based on annual crops and stored feeds **(**Jannasch et al. 2002). In addition, these authors found that the cost of production was $0.26/kg in the feedlot compared to $0.10/kg on pasture.

A carefully planned rotational grazing program can enhance pasture production and help control internal parasites. High-quality pastures and small-grain pastures are good for kidding since they provide excellent feed for milk production. Supplemental grazing in stubble fields, corn fodder, small-grain pastures, and brassicas can be used to either extend the grazing season or boost required nutrient levels for some critical phase of production. For example, Barkley et al. (2012) explained that moving goats out of pasture before the grass is less than 3 inches tall will help prevent internal parasite infection. Further, they mentioned that, in general, growth rates for meat goats are slower than those of sheep. Under favorable nutritional conditions, meat goats may gain at a rate of more than 200 grams (0.45 pounds) per day from birth to 100 days of age. When legume forages are established and managed in pastures, the possible pollution from commercial nitrogen (N) fertilizer can be minimized. *Rhyzobium* bacteria in association with legume roots fix nitrogen, which is utilized by the legumes and associated grasses for their growth and development. The economic value of the N fixed by legumes depends on the market price of the nitrogen fertilizer. Karki et al. (2013) highlighted that cultivation of different kinds of legumes and non-legume forages helped conserve farmlands, promote organic production, and reduce environmental pollution, which all added to the value of the land.

In addition to the previous findings, Australian Lot Feeder Association (ALFA) (2014) emphasized that grass-fed cattle are a key element in the carbon cycle. By grazing and through manure deposition, cattle help foster pasture growth, and hence, contribute to carbon sequestration in both plants and soils. Contrary to popular misconception, grass-fed cattle, when rotationally grazed, help reduce land degradation, desertification, and soil erosion. Grazing management through rotational grazing is another major aspect of managing pasture well and increasing the production and productivity of pastures. Undersander et al. (2002) highlighted the advantages of intensively managed rotational grazing over both continuous grazing and less intensive rotational systems. The advantages are more stable production during poor growing conditions (especially drought), greater yield potential, higher-quality forage available, decreased weed and erosion problems (80% of the Midwest pastures suffer from poor, uneven fertility coupled with serious weed and erosion problems), and more uniform soil fertility levels. The authors further expressed that the number of rotational graziers among dairy farmers was increased essentially from 0 to over 21% in the 1990s.

Methodology

Conceptual Framework

The impact of a "Year-Round Forage Production and Grazing Management Educational Program" was estimated using the production function approach proposed by Colman and Young (1989) (Figure 1). The Figure reflects that the existing production on a farm was Y_0 with X_0 inputs before the intervention of the educational events. With the series of intervention events (training/workshops, field days, technology, knowledge, skills, and improved management practices), the production curve of the same farm shifted up from PF_0 (original situation) to PF_1 (new level) with a corresponding rise in output (impact indicators that could be income/knowledge/skills/pasture availability) from Y_0 to Y_1 at the same level of given input (X_0). This means the educational interventions provided the respondents with at least two opportunities, as listed below, on farms that took part in the events.

1) More output (Y_1) could be produced with the same quantity of inputs (X_0)
2) The given level of output (Y_0) could be obtained with a reduced level of input usage (X_1), due to improved technology and management practices, with all inputs other than interventions held constant.

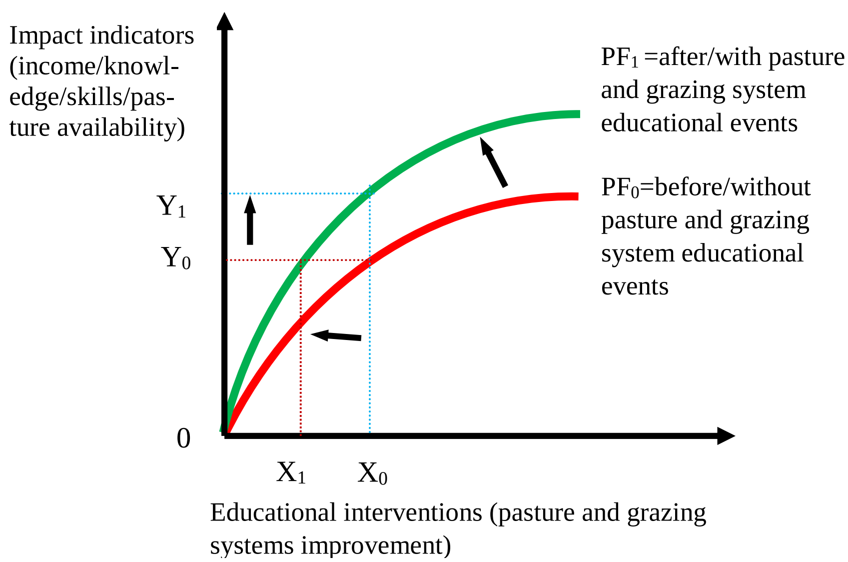

Figure 1. Production Function Approach to Assess Impact of an Intervention
Source: Modified from Colman and Young (1989)

Analytical Approach

Before versus After impact, Assessment Approach was applied to assess the impact of "Year-Round Forage Production and Grazing Management" educational events. The approach uses base-line information (vector of selected variables) of the farmers who were involved in the events and compared with the current conditions of the same farmers after the termination of the program. The selected impact indicators were knowledge, attitude, skills, aspiration, behavior (KASAB) perception, and condition (income). Thus, the difference between these two points (original and the current) reflects a change in condition. However, the change may not necessarily always be positive but indifference or negative as well. Correlation was carried out to investigate the degree of relationships between the educational events and technology adoption. The effect of the educational events was assessed using cross tabulation.

Hosting Institutions and Locations

The year-round forage production and grazing management program consisted of a package of educational events as highlighted in Figure 2. The activities were launched in a series as deemed necessary. In cooperation with the county extension offices, producers, and community-based organizations, Natural Resources Conservation Service (NRCS), and commodity groups, Tuskegee University Cooperative Extension (TUCE) organized these educational events at the regional, state, and county levels.

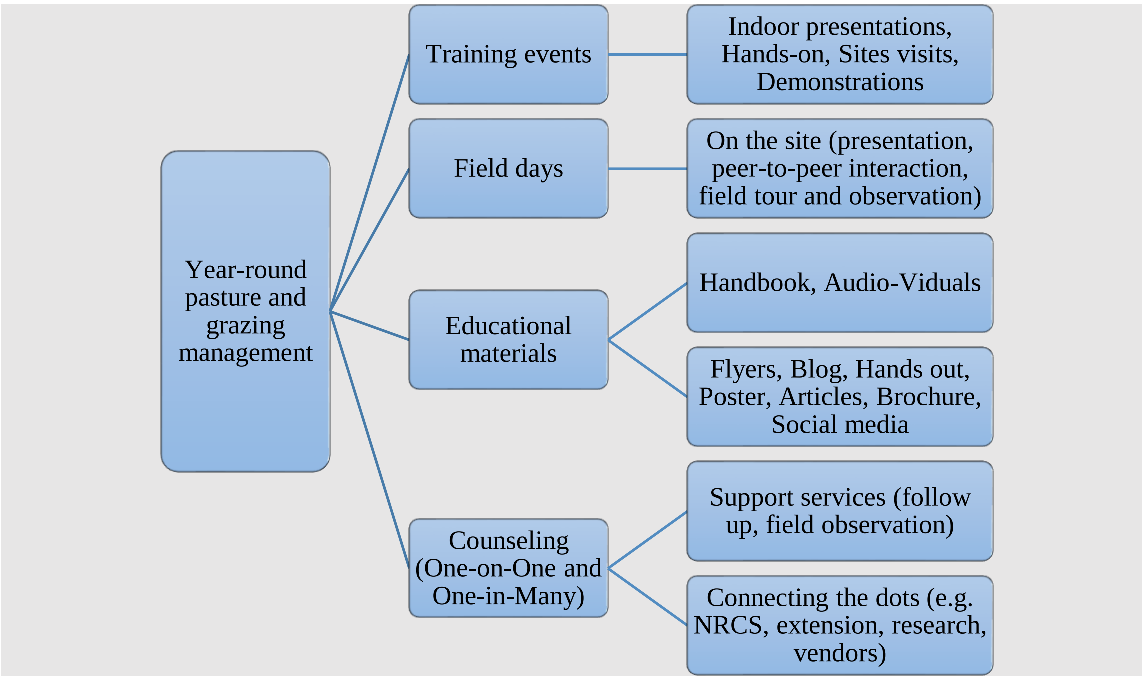

Figure 2. Pasture and Grazing Systems Improvement Events

Training/Workshops

Participants were trained intensively in establishing and managing cool-and warm-season forages (grasses and legumes) for extending the grazing period. Grazing component was one of the prime focuses on how to effectively utilize and preserve the available forages on pasturelands. Briefly, the training consisted of, but was not limited to the importance of year-round forage production; necessity of grazing/browsing management; forage definition and classification; suitable forages for small ruminants; basic agronomic and physiological principles of forage production; suitable forages for developing year-round grazing systems for small and large ruminants in the Southeast; facility development for pasture-based goat production under continuous, rotational, and other grazing systems; sustainable grazing management; identification and management of different browse species adapted to the Southeast; pasture weed identification and management; economics of year-round grazing; resource conservation and erosion control through a proper grazing plan and design; supplemental feeding of grazing animals; disease and parasite management and control; record keeping; and basics of farm economics and farm planning and budgeting. During the training programs, the participants were provided with educational materials (flyers, pamphlet, handbooks, relevant articles and papers, and recording formats). This program was initiated in 2011 and continued until 2017.

Field Days

The field days were also organized at various locations. Producers (especially the beginning and small-scale farmers) had opportunities to interact with peer farmers, share their experiences, and stories. The majority of the participants reported the field days as a very effective learning opportunity that confirmed 'learning by seeing' opportunities followed by hands-on exercises, such as collecting and preparing composite soil samples, identifying different forages, measuring the forage height, calculating available forage biomass in a particular plot, calculating the carrying capacity of the pasturelands, touring the site, observing planting equipment, fencing, and facilities (shelters, watering, and feeding), and discussing the local solutions.

Support Services

Some of the needy farmers (participants of the training events) were supported with a token amount of forage seeds, fertilizers, grazing sticks, soil packaging boxes, and information of the relevant vendors. Simultaneously, they were supplied with the information of supporting agencies, such as NRCS, Farm Service Agency (FSA), Extension Services (Alabama Cooperative Extension Services, TUCE, County Extension Offices, etc.) and relevant vendors. Farmers were also given technical services as per demand, such as soil testing, application of lime and fertilizers, inoculation of legume seeds, hoof trimming, checking parasite infestation, drenching, shed management, water and feed trough management, feeding practices, procuring animals with proven health records, connecting them with the marketing channels, market price information, and product processing information.

Follow-up and Monitoring

The list of the trainees (as stated above) was compiled and updated as the event happened. Communication was constantly maintained as per the objectives of the study; keeping them intact, providing them with relevant information as it was developed/produced and obtained to get them going, such as blog posts, emails, text messages, and phone calls. A few of the trainees' farms were visited randomly to observe the application of their knowledge and skills on the year-round pasture and grazing management. Successful stories were shared with other interested individuals during the events.

Data Collection and Analysis

A semi-survey questionnaire was designed taking into consideration the educational events (Figure 2) to improve year-round pastures and grazing system. The questionnaire consisted of yes/no, multiple choice, numerical, open, and closed types of questions. The surveys were introduced to 78 trainees [livestock producers (beginning farmers, and individuals thinking of starting farming), forestland owners, and professionals/part-time farmers] of the year-round forage production and grazing management system over the years. The respondents were also questioned about to the factors that influenced the adoption of pasture and grazing system improvements.

The surveys were introduced using the online SurveyMonkey tool to the trainees. They were constantly reminded through emails and phone calls to complete the survey. Also, triangulation of survey information was carried out. Additionally, in-person interviews and field observations were carried out with purposive sampling of 10% (i.e., eight) of the respondents to verify the application of acquired knowledge and skills to bring the desired change in the field. The collected data were processed and analyzed using SurveyMonkey, Excel, and SPSS tools.

Results and Discussion

A majority of trainees participated in multiple events. The response rate of the survey was 46% (i.e., 36 respondents), and the response was a reflection of an aggregated experience of the longitudinal period, 2011-2017. The frequency of participation by each respondent in the educational events was 2.5 times for training and 2.47 times for field days. The impact of these educational events on respondents' knowledge, attitude, skills, aspiration, and behavior (KASAB) were positively reported by 100% of the respondents. Similarly, the other aspects of the impact on technology adoption, economic implication, and multiplier effects of the events were well-received as the following narrative indicates.

Pasture Improvement

Figure 3 reveals that respondents applied all seven recommended practices (1, 2, 3, 4, 5, 6, and 7) for pasture improvement. Seventy-nine percent of the respondents collected and tested soil samples as the first step prior to planting forage. Based on the soil test results, 65% of them applied lime to maintain soil pH followed by application of fertilizers by 50% of the respondents. They planted both cool- and warm-season grasses and legumes. However, the legumes were planted by fewer respondents in both cool-season (29%) and warm-season (15%) planting periods, whereas, both cool- and warm-season grasses were planted by 62% and 41% of the respondents, respectively. The reasons for planting legumes by fewer percentages could be linked to the higher price of legume seeds.

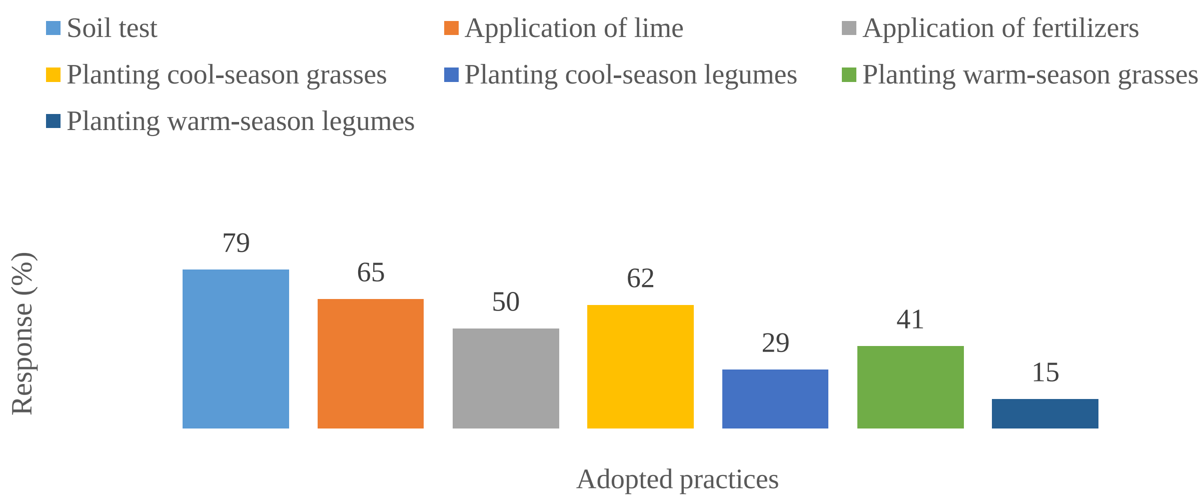

Figure 3. Improvements Made on Pasture after Attending the Educational Events

Grazing System Improvement

Improvements on the grazing systems were assessed in five major areas (Figure 4). Seventy-one percent of the respondents introduced cross fencing followed by 59% establishing paddocks on the pastureland. Sixty-five percent of the respondents practiced rotational grazing and managed the pasture effectively. Fifty percent of the respondents managed free access to drinking water and mineral supplement, and 38% introduced woodland grazing as another avenue of raising animals under natural vegetation without any concentrate. As reported by Karki et al. (2019, unpublished), the feeding cost was found to be much lower in the woodland grazing system by 156%, 44%, and 72%, respectively, than sack feed, hay feed, or a combination of both.

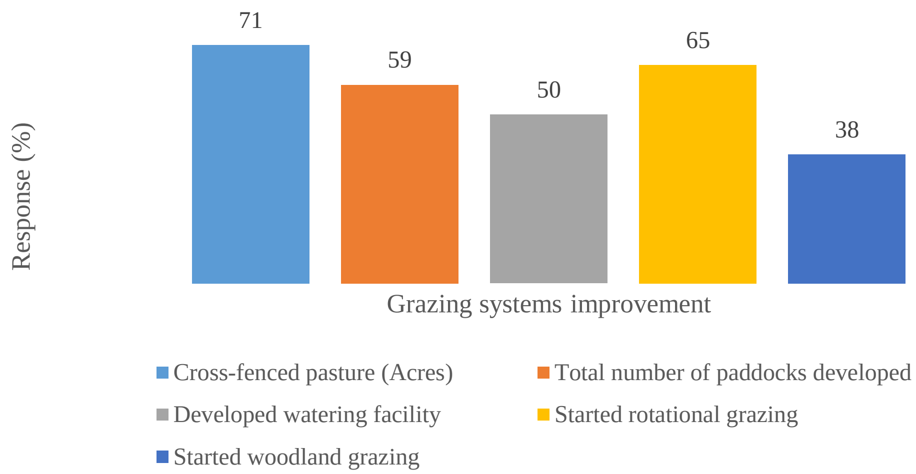

Figure 4. Improvements Made on Grazing Systems after Attending the Educational Events

Benefits from rotational grazing was illustrated by Undersander et al. (2002) showing graziers averaged about $200 more per cow net farm income than confinement dairy farms. Graziers averaged more than $1.50 net farm income per hundredweight equivalent of milk sold than achieved by confinement dairies. They further explained that beef, sheep, and diary heifer growing operations also reduced costs and increased profit from rotational grazing systems. Both start-up and maintenance costs were less for grazing compared to confinement systems. The authors further highlighted that rotational grazing also could increase the amount of forage harvested per acre over continuous grazing by as much as 2 tons dry matter per acre per year.

Adoption of Cool-Season Grasses

Fifty-five percent of the respondents cultivated cool-season grasses (Figure 5). The major grasses were rye, wheat, Max Q tall fescue, and oats by 55% of the respondents. The majority (62%) of them introduced annual rye followed by ryegrass (28%) (not shown in Figure). The total area planted with cool-season grasses was 430 acres, which was 21 acres per adopter, respondent.

Adoption of Cool-Season Legumes

Forty-four percent of the respondents cultivated cool-season legumes (Figure 5). The major cool-season legumes planted were clover (white, crimson, ladino, red, and arrow-leaf), sun hemp, and serecia lespedeza on 164 acres. The average area of legume planting was 18 acres per adopter. The rate of cool-season legume adoption was found lower than grasses both in terms of adopters and area under cultivation.

Adoption of Warm-Season Grasses

Also, 42% of the respondents cultivated warm-season grasses (Figure 5). The major warm-season grasses planted were brown top millet, sorghum- Sudan, Bermuda, Bahia (Pensacola), Russian comfrey, and gama. The total cultivated area was 115 acres, which was 7.6 acres per adopter. Rogers (2003) reported that innovation diffusion occurs through five adopter categories, namely, innovators, early adopters, early majority, late majority, and laggards. The rate of adoption in this study ranged from 42% to 55%, respectively, for warm-season grasses and cool-season grasses. The adopters mostly belonged to three categories: innovators, early adopters, and early majority. There were a large percentage of late majority and a small number of laggards due to resource constraints.

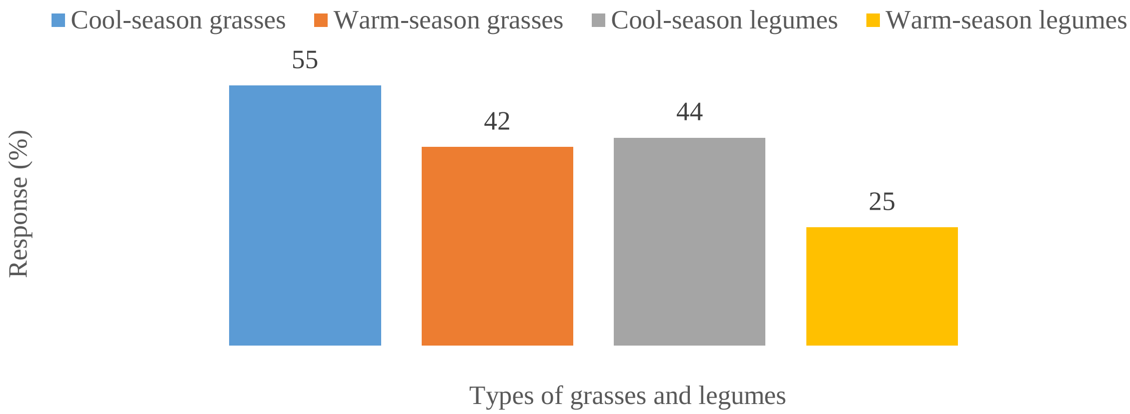

Figure 5. Adoption Rate of Cool- and Warm-Season Grasses and Legumes

Adoption of Warm-Season Legumes

Unlike grasses, the number of adopters and the total area under legumes were less than in warm-season legumes. Twenty-five percent of the respondents planted warm-season legumes. The major legumes planted were clover (red and white), red ripper pea (cowpea), sun hemp, and hairy vetch, and the area under cultivation of warm-season legumes per adopter was 8 acres.

Karki and Karki (2017) reported that the adoption rate of cool-season pastures (grasses and legumes combined) increased by 88% (from 8 acres in 2013 to 15 acres in 2015) on a beef cattle farm, Union Springs, Alabama due to the educational events. Consequently, the owner increased the cattle herd from 40 to 54. In a study carried out in Phenix City, Alabama, Karki et al. (2013) recorded that a goat farmer with 35 goats reduced the monthly feeding cost by 79% during January-April after the adoption of cool-season pastures (grasses and legumes combined). Similarly, the rate of adoption of cool season pasture was increased by 75%, thereby reducing the feeding cost by 73% by a beginning farmer with 40 goats in Selma, Alabama. Both of these farmers applied acquired knowledge from educational events to pasture development technology.

Multiplier Effects of the Educational Events

A multiplier effect of the educational program on year-round pasture improvement and grazing management was estimated by calculating spill over, percolation, dissemination, and transfer of acquired knowledge and skill by the trainees to other people (beginning farmers, interested individuals, young and prospective farmers, community people, friends, families, and relatives). An aggregated multiplier effect of the educational events reached over 892 people through the respondents. It is calculated that one respondent multiplied his/her acquired knowledge and skills as a 'snow balling effect' to over 25 individuals during the program period (2011-2017). Annual knowledge multiplier was found to be 6/respondent/activity (Table 1). The multiplier effect of the educational program was measured in four major categories as illustrated in Table 1.

Table 1: Multiplier Effect of the Educational Events on Improving Pastures and Grazing Systems

Knowledge and skill multiplication	Total output (number)	Knowledge and awareness multiplier
Number of people (producers) receiving knowledge and skills	216	6
Number of people (producers) receiving educational materials	222	6
Number of people (producers) toured respondents' improved pastures/fields	222	6
Number of people (producers) receiving information about training opportunities at TUCE and relevant information	232	6
Total	892	24

According to the respondents, the knowledge and skills acquired from the educational events were transferred to the neighboring farms, adjoining communities, and beyond (i.e., multiplied over) without any additional costs. The respondents used their farms as contact farms and demonstration sites in their respective communities and neighborhoods where many families, friends, and community members visited and/or heard them talking about educational programs for improving pastures and grazing systems.

Economic and Associated Impacts

Ninety-six percent of respondents reported that grazing opportunity increased greatly due to the first-time planting of cool-and warm-season forages. The forage growth was vigorous. Cross fencing was done to manage pastures well through rotational grazing. Due to the abundant pasture, animals gained weight (growing and newborns) as stated by 67% of the respondents. Breeding animals performed much better than the previous years due to enough green pasture, according to 67% of the respondents. Likewise, health problems of the animals decreased as reported by 70% of the respondents. The expenses for medicines also went down by a large extent, as respondents did not spend on medicines in comparison to previous years. The most cost-absorbing item for raising animals is 'concentrate feed' and the purchase of such feed was reduced to zero during the entire grazing period as stated by 69% of the respondents. None of the respondents reported the need for buying supplemental feed due to enough green pasture. As explained by 69% of the respondents, the labor requirement for feeding and taking care of animals was reduced significantly.

Similar findings were reported by Karki (2013) that the labor requirement was reduced by an hour/day. Hence, several hundred man-days were saved that otherwise would have been used for feeding, management, and taking care of goats and cattle during the lean season of forage production. Undersander et al. (2002) illustrated that rotational grazing requires only 15 minutes per day to move animals if paddock and fencing design is efficient. In contrast, feeding hay and silage in a confinement system may take 20 minutes to 1 hour. They further elaborated that grazing may also decrease time to make hay, which takes an average of 7 hours per acre each season. Simultaneously, it also reduces the time to haul manure because most manure is dropped by the animal on the pasture. Apart from various benefits, the most tangible outcome of the pasture was on reduced feeding cost as highlighted by 82% of the respondents. The practice of buying sack feed/concentrate/grains/byproducts was completely stopped during the grazing period. The cultivated pasture was more than enough to graze their animals, they stated. Simultaneously, the soil health of the pastureland was increased impressively as experienced by 90% of the respondents. According to them, the deposition of organic matter improved the soil structure, texture, retained moisture, and neutralized the pH. As the aggregate effect of the program, the household income increased as per 67% of the respondents.

Factors Affecting the Adoption of Pasture and Grazing Systems Improvement

A majority (67%) of respondents mentioned money, time, size of farm, number of livestock, equipment and machinery, technicalities (soil testing, lime and fertilizer application) as major factors impeding the adoption process. Of the influencing factors, monetary resources (grants/funds) to buy: seeds (grass and legumes), lime (as per the soil test results), fertilizer (as per the recommendation), pay for soil testing (mailing and standard lab analysis), fencing (mostly labor and upfront investment until reimbursement by the NRCS), and equipment and machinery (tractor, leveler, driller, spreader) were reported major challenges.

Ways of Improving Pastures and Grazing Systems

Figure 6 shows respondents' views on ways of improving year-round pasture and grazing systems. Of the activities listed, 87% indicated continuously improving the grazing systems; 77% indicated continuously managing improved pastures; 73% mentioned introducing high yielding leguminous forages; 67% mentioned improving pasture in the remaining pastureland; 63% mentioned introducing high yielding grasses, and 50% mentioned improving silvopasture systems. Only 37% mentioned woodland grazing. These responses inferred the respondents' strengthened knowledge and skills regarding the scope and importance of the various ways of improving pasture and grazing systems.

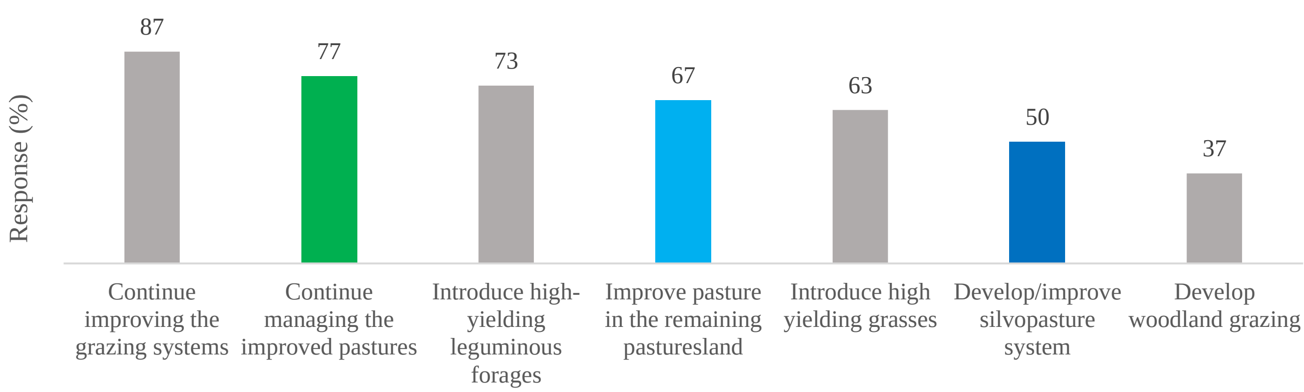

Figure 6. Ways of Improving Year-Round Pastures and Grazing Systems

Relationship between Educational Events and Technology Adoption

Table 2 shows the correlation coefficient between educational events and year-round pasture and grazing improvements. The results revealed a positive correlation between the educational events and adoption of pasture ($p<0.05$) and grazing improvement activities ($p<0.01$). Application of the acquired knowledge and skills resulted in a significantly positive impact on the application of lime ($p<0.05$), application of the recommended fertilizers ($p<0.05$), planting of cool-season grasses (p<0.10), planting of cool-season legumes (p<0.01), planting of warm-season grasses (p<0.05), and planting of warm-season legumes (p<0.05).

Table 2. Correlation Coefficients of Educational Events and Year-Round Pasture and Grazing Improvements

Participation in educational events	Pearson Correlation	1						
	N	36						
Application of lime	Pearson Correlation	.383*	1					
	N	32	32					
Application of fertilizers	Pearson Correlation	.201	.419*	1				
	N	31	31	31				
Plantation of cool season grasses	Pearson Correlation	.072	.313	.140	1			
	N	33	32	31	33			
Plantation of cool season legumes	Pearson Correlation	.273	.324	.131	.681**	1		
	N	27	26	25	27	27		
Plantation of warm season grasses	Pearson Correlation	.263	.232	.234	0.395	.439*	1	
	N	29	27	26	28	25	29	
Plantation of warm season legumes	Pearson Correlation	.155	-.233	.231	.145	.060	.513*	1
	N	24	23	22	24	23	24	24

Note: * is 10%, and ** is 5% (2-tailed)

Educational Program and Pasture Improvement

The Chi-Square results confirmed a significantly positive impact of educational events on strengthening farmers' knowledge and the application of recommended lime and fertilizers (p<0.05) to improve pasture, and thereby, increase production and productivity (Table 3). The increased production could ultimately lead to increased household incomes.

Table 3. Impact of Educational Events on Pasture Improvement

Variables	Pearson Chi-Square Value	df	Significance level
Fertilizer application	8.135	2	0.017
Likelihood Ratio	6.717		0.035
Number of cases	36		
Liming	4.693	1	0.030
Likelihood Ratio	4.955		0.026
Number of cases	32		

Further Needs for Training

Adoption of pasture is not a sufficient condition; rather, it requires continuous practice. The change in condition due to adoption of the technology is the desired output. In order to keep the change sustainable, respondents proposed further training, including field days, workshops, and hands-on activities (Table 4).

Conclusion

The findings of the study confirmed that the educational events (training programs, field days, educational materials, and counseling), impacted positively on farmers' knowledge and skills, technology adoption, reducing production costs, and increasing household incomes. Educational events underpinned two major practices of a sustainable animal production system by strengthening year-round pasture production and grazing management. Therefore, educating farmers through a hands-on approach, regular field visits, and on-site technical support are the key factors to bringing positive changes in their attitude, behavior, skill level, and farm's condition.

Table 4. Training Needs for a Sustainable Pasture and Grazing Systems Improvement

Topics of the training	Contents proposed	Response (%)
Grazing management	Carrying capacity, stocking density/acreage of pastureland (silvopasture, woodland grazing, year-round pasture, browsing), retaining animals in each compartment, bases of rotational grazing, plants stand on the ground, judging the quality of hay	42
Economics of pasture management	Minimizing cost of production of pasture and grazing, farm resource management, basics of farm economics, record keeping and farm data analysis, farm planning and scheme preparation for goats and sheep, economics of silvopasture, woodland grazing, and year-round pasture	37
Health management	Parasites and diseases control	8
Others	Biosecurity & timely flow of information	5

Correspondingly, educational programs enabled respondents to generate multiplier effect of acquired knowledge and skill with no additional cost. It is recommended that extension should intensify the educational programs and constantly reach out to trainees with full technical assistance and support services that directly help them stay in farming and increase indirect impact of the extension activities through spillover effect.

References

ALFA. (2014). "Grass Fed versus Grain Fed Beef." http://www.feedlots.com.au/wp-content/uploads/2014/07/grassvgrain.pdf [Retrieved January 19, 2019].

Al-Khaza'leh, J., R.C. Al-Baqain, and A.V. Zárate (2015). "A Comparative Economic Analysis of Goat Production Systems in Jordan with an Emphasis on Water Use." *Livestock Research for Rural Development* 27 (5): Article 81.

Barkley, M.E., K. Knoll, L.F. Kime, and J.K. Harper (2012). "Meat Goat Production." Penn State Extension, Pennsylvania State University, University Park, PA.

Bossis, N. (2012). "Economic and Environmental Performances of Dairy Goat Farming Systems: The Impact of Pasture." *Fourrages* (212): 269-274. https://www.researchgate.net/publication/289995067_Economic_and_environmental_performances_of_dairy_goat_farming_systems_The_impact_of_pasture [Retrieved January 10, 2019].

Coffey, L. (2006). Meat Goats: Sustainable Production. A Publication of National Center for Appropriate Technology (ATTRA) - National Sustainable Agriculture Information Service, Butte, MT.

Colman, D., and T. Young. (1989). *Principles of Agricultural Economics. Markets and Prices in Less Developed Countries.* Cambridge, England: Cambridge University Press.

Eftimova, E., N. Mateva-Dubrova, I. Ushlinovska, N. Pacinovski, and A. Palashevska (2014). "Production and Economic Results of Organic Goat Farm in Gevgelija Region." *Journal of Hygienic Engineering and Design* 7: 186-189.

Gillespie, J., M. D. Woodin, and R. Nehring (2012). "The Economics of Organic Versus Conventional Cow-calf Production." Department of Agricultural Economics and Agribusiness, Louisiana State University Agricultural Center, Baton Rouge, LA.

Jannasch, W.R., T. Stewart, A.H. Fredeen, and R.C. Martin (2002). "A Comparison of Pasture-Fed and Feedlot Beef." Organic Agriculture Center of Canada (OACC). http://organicagcentre.ca/ResearchDatabase/res_grass_vs_feedlot.asp [Retrieved January 19, 2017].

Karki, L.B., U. Karki, S. Bhattrai, and B. Paneru (2019). "Impact of Woodland Grazing in Minimizing Production Costs for Raising Animals in the Southeast." North American Agroforestry Conference (NAAC), June 24-27, Corvallis, OR.

Karki, L.B., and U. Karki (2017). "The Socioeconomic and Ecological Impact of Cool Season Forage Production: A Case of Black Belt Counties, Alabama." *Professional Agricultural Workers Journal*: 4 (2): 1-15. http://tuspubs.tuskegee.edu/pawj/vol4/iss2/9 [Retrieved July 01, 2019].

Karki, L.B. (2013). "The Economics of Year-Round Forage Production and Grazing/Browsing Management." In U. Karki, (ed.), *Sustainable Year-Round Forage Production and Grazing/Browsing Management for Goats in the Southern Region*. (Publication No. TUAG0213-01). Tuskegee, AL: Tuskegee University.

Karki, U., L.B. Karki, N. Gurung, and A. Elliott (2013). *Cool-Season Forages for Sustainable Goat Production: On-Farm Research Highlights*. No. TULIV-1311-01. Cooperative Extension Program, Tuskegee University, Tuskegee, AL.

Kieser, L.T. (2008). "How Much Does It Cost to Raise Dairy Goats?" *Dairy Star*, May 2 Issue. http://www.extension.umn.edu/agriculture/dairy/business-tools-and-budgeting/cost-to-raise-dairy-goats/ [Retrieved January 14, 2019].

Kumar, S. (2007). "Commercial Goat Farming in India: An Emerging Agri-Business Opportunity." *Agricultural Economics Research Review* 20: 503-520.

Luginbuhl, J. M. (2016). "Sustainable Production of Meat Goats: Grazing Strategies and Forage Utilization." *Dialnet: Latin American Animal Production Files* 24 (2): 95-99. https://dialnet.unirioja.es/ejemplar/509697 [Retrieved July 3, 2019].

Luginbuhl, J.M. (2006). "Pastures for Meat Goats." In T.A. Gipson, R.C. Merkel, K. Williams, and T. Sahlu (eds.), Langston University, Langston, OK

Rogers, E.M. (2003). *Diffusion of Innovations*, 5th ed. New York, NY: Free Press.

Singh, M.K., A.K. Dixit, A.K. Roy, and S.K. Singh (2014). "Analysis of Prospects and Problems of Goat Production in Bundelkhand Region." *Range Management and Agroforestry*, 35 (1): 163-168.

Solaiman, S.G. (2006). *Feeding Management of a Meat Goat Herd*. Technical Publication, No. 06-11, Cooperative Extension Program, Tuskegee University Tuskegee, AL.

Undersander, D., D. Albert, D. Cosgrove, D. Johnson, and P. Peterson (2002). Pastures for Profit: A Guide to Rotational Grazing. Publication Number A3529. Cooperative Extension, University of Wisconsin. USDA ERS Organic Production Datasets. http://www.ers.usda.gov/data/organic/#statedata [Retrieved January 17, 2019].

Wong, J., U. Raghunathan, C. Escalante, and K. Wolfe (2008). "Grass-Fed versus Organic Dairy Production: Southeastern, US. Willingness to Pay." Paper Presented at the American Agricultural Economics Association, Annual Meeting, July 27-29, Orlando, FL.