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Barriers to Management Intensive Grazing by Southern Dairy Farmers

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BARRIERS TO MANAGEMENT INTENSIVE GRAZING BY SOUTHERN DAIRY FARMERS

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Abstract

Interest in Management Intensive Grazing (MIG) [a situation where grazing animals are moved to a fresh pasture every few days in order to have access to adequate forage] practices by farmers have increased steadily over the years. Many research publications on grazing advocate the financial and environmental benefits of grazing. Understanding the challenges of MIG can be an important piece of information for a dairy farmer. A survey was conducted to determine how farmers in the southeastern region perceive the barriers to the adoption of MIG. A greater percentage of MIG southeastern farmers were satisfied or very satisfied with their farm profit level compared to other practices. However, the amount of work to start pasture management, and the lack of on-farm technical assistance were barriers for many MIG operations.

Keywords: Management Intensive Grazing, Grazing Systems, Southern Dairy Farmers, Dairy Farmers

Introduction

Interest in management intensive grazing (MIG) practice by farmers have increased steadily over the past years. However, farmers with confined feeding practice have contributed to the growth of the large scale dairy operations in the U.S. According to O'Donoghue et al. (2011), farmers might have been influenced to find cheaper capital in the form of specialized animal housing, feeding, and manure management facilities to reduce expensive land and labor cost and lower the cost of production per animal. Compared to the confined feeding (CONF) practice, MIG practice allows the cattle to graze on one portion of a pasture while other areas of the pasture are rested, allowing a recovery time. The question is, "can MIG practices that raise cattle under less confined conditions limit the growth potential of CONF operations?" For instance, Winsten et al. (2010) assessed the views of northeastern farmers on the barriers to the adoption of MIG practices. The farmers were of the view that financial, capital, and managerial requirements were the main barriers to adopting MIG practices.

A survey of literature on MIG operations shows that many of the studies done on the subject often used data collected primarily from farmers in the northeastern states. In comparison, there have been limited studies on how dairy farmers in the southeastern states view MIG practices. Therefore, a couple of questions can be raised, which are, "are the perceptions about MIG among southeastern dairy farmers similar to those of northeastern dairy farmers" and "what are the actual challenges for southeastern dairy farmers that practice MIG?" To answer these questions, this study was conducted in Georgia and Florida. Although there are other states which make up the southeastern region, Georgia and Florida are leading dairy states because of the greater number of dairy producers in these states compared to the rest of the southeastern region. Additionally, Georgia and Florida are the two highest ranking southeastern states in terms of marketed milk value, accounting for a total of $810,838,000 in 2016 (USDA NASS, 2016). The objectives of this study were to (1) determine whether or not MIG is a farming method that southeastern dairy farmers are interested in adopting, (2) ascertain how difficult it is for farmers to transition their

farms into an MIG operation, (3) assess what farmers believe the barriers to adopting MIG are, and (4) assess the impact farmers believe MIG would have on their farms.

Literature Review

Many research publications on grazing advocate the financial and environmental benefits of grazing. Bartlet et al. (2016) conducted a study of small beef cattle and meat goat producers' practices and stressed that feeding concentrate should be discouraged as much as possible to save money in the long run. Lichtenberg et al. (2011) pooled financial data collected over a 15 year period 1995-2009 and examined comparisons between technical efficiency, profitability, and risk in MIG and CONF dairy operations. The analysis showed that MIG farms were not necessarily at a disadvantage in terms of efficiency. Additionally, the study showed that profitability is less risky in MIG than in CONF operations and indicated that farmers with off-farm income tended to be less efficient while farmers with more experience and farmers with children tended to be more efficient. In another study, Johnson et al. (2014) found that the profits of MIG farms faced less income risk than CONF farms and the cost for veterinary, breeding, and medical associated costs were much less for pastured cows than confined cows. The veterinary, breeding, and medicine costs in MIG farms were $81/cow verses $179/cow in CONF farms, and cows raised in the grazing system were generally seen as healthier than being confined. The study determined that MIG farms with less than 200 cows were more profitable than CONF farms on per cow, per milk-weight, and per acre basis and that farmers using MIG systems spent less time in crop production, feeding, and manure management than that of CONF dairy farms.

Furthermore, Winsten et al. (2010) found factors such as income, land, and labor to be great barriers to MIG adoption by CONF farmers. However, MIG and traditional (TRAD) farmers, found lack of grazing land for grazing to be a significant challenge. They also reported that the dairy farmers who operated CONF style, on average, had much larger farm sizes and produced more milk per cow, while the farms that were using MIG usually had lower production costs. Both CONF and MIG operations produced significantly higher rates of return on farm assets than farms using a mixed feeding system. The analysis further showed that herd size, milk production per cow, debt level and veterinary expenses to farm profitability were very important to each system. A four-year study by White et al. (2002) showed that milk production was lower for pasture based systems than confinement system; however, lower feed costs, lower culling costs, and other economic factors indicated that pasture-based dairy systems could compete with confinement dairy systems.

Methods

A survey instrument was developed. The instrument consisted of questions related to herd size, milk production, land use, farmer characteristics, technologies, management practices, satisfaction with current practices, concerns for long-term farming, and feeding and grazing practices. Next, a mail survey was conducted by Fort Valley State University, the University of Georgia, and the University of Florida in 2012. To achieve high response, all survey respondents were promised to be entered into a lottery drawing of a $300 cash prize. The questionnaire was six pages long and it was requested to be completed by someone who was making management decisions for the farm. Both Georgia and Florida had over 300 dairy producers in 2012 (USDA NASS, 2017). Therefore, surveys were mailed to almost all dairy farmers in the two states.

Respondents were instructed to separate sections based on whether or not they were using grazing practices for their dairy herd in 2012. Farmers that said that they were non-grazers were asked a series of questions and asked to rate from 1-5 based on how much of a challenge it would be for them to adopt grazing systems. One (1) was viewed as not being a significant challenge and five (5) was viewed as being a significant challenge. The variables that were asked to be ranked were: "Decrease in milk production per cow", "Decrease in cash flow", "Decrease in farm profits", "Lack of information on pasture management", "Lack of on-farm technical assistance", "Amount of work to start rotational grazing", "Amount of work to manage rotation grazing", "Skepticism from other farmers", "Skepticism from family members", "Difficulty producing enough winter feed", and "Not enough land for grazing." Farmers who responded that they used grazing practices for their dairy herd were asked, "what the challenges were?" These questions helped to determine what the actual barriers in adopting grazing practices for southeastern farmers are versus the perceived barriers to adoption from the perspective of non-grazers. Additionally, the grazers were asked, "During the 2012 grazing season, how often did you move your milking cows to a fresh pasture/paddock when adequate forage was available?" The purpose was to conduct a comparative study to understand the level of challenges depending on the days of grazing.

In order to gain deeper knowledge about the various production types, all farmers were asked about their satisfaction level. "How satisfied were you in 2012?" Various aspects such as satisfaction with the amount of time away from the farm, satisfaction with their farm profit level, and satisfaction with their heard health were asked. Farmers rated from 1-5 based on one (1) as very dissatisfied, and five (5) as very satisfied for these aspects. Similarly, farmers were asked to indicate their level of concerns for the long-term survival of their dairy farm such as milk price, milk production costs, farm profitability, and current herd size. To understand farmers' future planning a series of follow up questions was asked: "How likely are you to make changes to your dairy farm in the next 5 years?" Several planning features were considered such as "transition farm to family member", "go out of business", "go to on-farm processing", and "increase herd size." A total number of 126 completed surveys were returned.

Results and Discussion

This study categorized each farm as confined feeding (CONF), management intensive grazing (MIG), or traditional (TRAD). The days of grazing within an individual paddock must be kept to a minimum in a MIG system and the herd should be rotated to a new paddock within three to four days (UGA, 2017). Hence, a farm was considered as MIG type if the milking cows were moved to a fresh pasture within 3 days or less during the grazing season when adequate forage was available. A farm was considered as TRAD if grazing was less intensive and considered as CONF if pasture was not used as a source of forage at all. Results of the survey showed that 29% of the farms were MIG, 39% were TRAD, and the rest, 32%, were CONF farms.

Farmers were asked to provide the number of their milking cows, dry cows, heifers, and calves. Herd size was determined by totaling farms' milking cows, dry cows, heifers and calves. Milk production/cow/year was considered as an important factor to compare with production systems. Some respondents reported the milk production in lbs. / cow/year. Others reported as milk production/farm/year, or milk production/cow/day. For the respondents who reported yearly milk production for their farm, it was divided by the number of milking cows to obtain milk production/cow/year. But for those who reported daily production per cow (milk production/cow/day), it was multiplied by 365 to obtain milk production/cow/year. There were a

few outliers in the latter indicator, and this may be due to typing errors and these were replaced with the median value of 19,000lbs/cow/year. Farmers were asked for their detailed crop acreage and the total acreage was obtained by adding all crop acreages. Table1 shows that the CONF farms had larger herd size, more acreage, higher milk/cow/year production than MIG, and TRAD farms. The results are similar to those obtained by Winsten et al. (2010) for the northeastern region The mean age of all of the respondents was 55 years, with a minimum age of 22 years and a maximum age of 87 years (not shown in Table). More CONF farmers had completed bachelor's degree or beyond than their MIG and TRAD counterparts (not shown in Table). There were few females as primary decision makers in all of the three production systems (not shown in Table).

Table1. Mean (and Median) Herd Size, Acres and Milk per cow by Production System

Table1	Herd size	Acres	Milk production per cow (lbs./year)
CONF	2038 (800)	1097 (415)	24961 (21646)
MIG	765 (370)	513 (328)	20545 (16425)
TRAD	642 (255)	445 (265)	17942 (19000)

Much of the increased dairy farm productivity are attributed to improved management practices, and technology adoption such as breeding technologies with improved genetics (Shook, 2006), addition of automatic take-offs (Tranel, 2008), using a nutritionist to design mixes or purchase feed, and using recombinant bovine somatotrophin (rbST) (Raymond et al., 2009). Hence, the intensity of adoption of various technology and management practices among the three production system were studied (Table 2). Following Winsten et al. (2010), chi-square tests were used to determine if the use of technologies and management practices differed with the types of production system. This study observed similar results as Winsten et al. (2010), specifically, written nutrient management plan and total mixed ration were used by most CONF farmers compared to MIG and TRAD farmers. Though milking parlor was mostly used among all of the three production types, CONF farms adopted the highest percentage of milking units with automatic take-offs and were most likely to employ a nutritionist and use recombinant bovine somatotrophin (rbST). A vast majority of CONF farms were likely to use computers for farm management, crop nutrition/management consultant; whereas less than 17% of MIG and TRAD farmers used farm financial consultant.

Farmers' Satisfactions, Concerns for the Future, and Likelihood of the Business

Farmer's satisfaction levels, and planning for future business are important elements for developing and sustaining dairy farming practices. Psychology measures may reveal how multiple life satisfactions vary with the farm production methods. Farmers may also choose a method to attain higher satisfaction. Hence, farmers' satisfaction such as satisfaction with the amount of time away from the farm, satisfaction with their farm profit level, and satisfaction with their herd health were examined (Table3). It was observed that a higher percentage of MIG farmers were satisfied or very satisfied with the amount of time away from the farm relative to TRAD and CONF system (39.39%, 16.67%, and 30.56%). Similar to Winsten et al. (2010), a greater percentage of MIG southeastern farmers said that they were satisfied or very satisfied with their farm profit level than TRAD and CONF (23.53%, 7.14%, 20.00%); and MIG and

Table 2. Percentage of Farmers using Various Technologies and Management Practices, and the Chi-square probabilities

	CONF	MIG	TRAD	TOTAL	Chi-sq prob
Milking Parlor	100	97.06	93.33	96.55	0.2531
Automatic Takeoffs***	77.78	35.48	27.91	46.36	<.0001
Written Nutrient Management Plan***	91.43	64.52	43.18	64.55	<.0001
Manure Storage Pit***	94.12	83.33	63.64	78.70	0.0038
Custom Manure Hauling	36.67	24.14	19.05	25.74	0.235
Total Mixed Ration (TMR) ***	91.67	51.61	71.11	72.32	0.0012
DHIA 5i	78.38	54.84	68.18	67.86	0.1171
Artificial Insemination*	94.59	75.76	80.95	83.93	0.0809
Computer for Farm Management**	83.78	66.67	55.81	68.14	0.0271
Farm Financial Consultant**	41.18	16.67	15.56	23.85	0.0168
Crop Nutrition/ Management Consultant***	66.67	16.13	21.43	33.96	<.0001

The * indicates significant differences exist across the three farm types at the 10% level; ** indicates at the 5% level; and *** indicates at the 1% level.

Table 3. Percentage of Respondents for their: Satisfaction, Concerns for Future, and Likelihood for Business

	MIG	TRAD	CONF
Satisfaction: satisfied or very satisfied			
Amount of Time Away from the Farm	39.39	16.67	30.56
Farm Profit	23.53	7.14	20.00
Financial Progress	32.26	20.93	35.29
Herd health	73.53	74.42	62.86
Concerns for future: concerned or significantly concerned			
Milk prices	87.88	73.33	75.68
Milk production costs	85.29	84.09	86.49
Profitability	88.24	84.44	75.00
Current herd size	35.29	31.11	27.78
Likelihood for business: likely or very likely			
Transition to family members	16.22	38.24	22.22
Go out of business	16.67	29.41	33.33
Increase herd size	51.35	47.06	38.64
Go to on farm processing	5.56	17.65	9.52

TRAD farmers seems to be satisfied or very satisfied with their heard health compared to CONF system (73.53%, 74.42%, and 62.86%). However, more than 73% in all of the three types were

concerned about future milk price, milk production cost, and profitability. A greater percentage of TRAD farms were likely to transition to family members than MIG and CONF. Even though the personal success in using MIG method was reflected in farmers' work satisfaction and commitments to alternate methods, there were many farmers without grazing practice in this region. Hence, this study further searched for the explanations for farmers' unwillingness to adopt the MIG practice despite the fact that grazing is attainable during most of the year in the southeastern region.

Perceived Challenges to Rotational Grazing by Non-Grazers versus Actual Challenges to Grazing by Grazers

The perceived challenges to adopt rotational grazing by non-grazers, as well as the actual challenges to grazing by grazers were examined (Table 4). Similar to the northeast, a greater percent of CONF farmers perceived the production challenges as an obstacle relative to the grazers (Winsten et al., 2010). More than two-thirds of CONF farmers' perceptions of decrease in milk production, decrease in farm profits, and decrease in cash flow appeared to be a challenge if they adopted rotational grazing (86.11%, 75.00%, and 72.22%). Whereas, more than 80% of the farmers who actually used pasture as a source for their milking cows felt decrease in milk production, decrease in farm profits, and decrease in cash flow were not considered challenges. CONF farmers' perceptions of the decrease in milk production might have been triggered due to the less controlled nature of the forage component with a grazing system, and managing the supplemental feeding with grazing systems would be more difficult than CONF systems. As suggested by USDA NRCS (2007), policies through nutritional programs/guidelines to obtain comparable milk production per cow in grazing systems would attract southeast CONF farmers to adopt pasture based systems.

Table 4. Percentage of Grazers for Actual Challenges to Grazing and Percentage of Non-Grazers for Perceived Challenges to Rotational Grazing

	Actual challenges to grazing MIG (%)	Actual challenges to grazing TRAD (%)	Perceived challenges to rotational grazing CONF (%)
Decrease in milk production	18.75	18.18	86.11
Decrease in farm profits	15.63	6.06	75.00
Decrease in cash flow	16.13	15.15	72.22
lack of information on pasture management	35.48	15.15	23.53
Lack of on farm technical assistance	45.16	9.38	23.53
Amount of work to start pasture management	38.71	15.15	30.30
Amount of work to manage pasture grazing	40.00	20.59	39.39
Skepticism from other farmers	26.67	12.12	3.03
Skepticism from family members	13.33	6.06	15.15
Difficulty producing enough winter food	35.48	32.35	67.65
Not enough land for grazing	19.35	29.41	71.43

This may suggests that the MIG and TRAD farmers viewed pasture as a low cost feed method. Unlike the CONF operations, grazing operations do not require highly capitalized systems of equipment or infrastructure such as large waste management systems, feed storage and handling equipment (USDA NRCS, 2007). Perhaps, respondents who practiced grazing believed that the cost savings resulted in earning good net profit and felt as though it was not a challenge.

The study examined if some of the management and social attributes were challenges for adopting grazing system. More than two-thirds of the farmers from the three categories said that skepticism from other farmers and skepticism from family members would not be a challenge to adopting rotational grazing. Similarly, more than two-thirds of CONF farmers said that lack of information on pasture management, lack of farm technical assistance, and amount of work to start pasture management would not be a challenge if they adopted rotational grazing (76.47%, 76.47%, 69.70%). This may suggest that the reluctance to adopt rotational grazing practices might be due to factors other than these pasture management and social attributes.

About two-thirds of CONF farmers felt that difficulty producing enough winter feed was a challenge if they adopted rotational grazing. Perhaps they believed that the required feed and forage in the winter on a fixed land would be a great challenge. Whereas, difficulty producing enough winter feed was seen as a significant challenge by 35.48% of the MIG farmers, and 32.35% of the TRAD farmers. During the winter seasons, it is important that dairy cattle obtain the proper amount of nutrients they need but unfavorable weather conditions in the southeastern region may limit the forage availability. Possibly, MIG dairy farmers practiced “stockpiling” a process where pastures are un-grazed during the fall so that the cows can graze these pastures during the winter months. Also, producers might have used hay bales combined with other forage crops to ensure proper nutrition. The variable not enough land for grazing was also viewed as a greater challenge for CONF farmers than it was for either TRAD or MIG farmers (CONF: 71.43%, MIG: 19:35%, TRAD: 29.41%). Pasture availability is one of the many factors that farmers must consider when deciding if MIG is a viable farming method for their operations. The study noted that the CONF farms had larger acres than MIG and TRAD operations. Hence, interested CONF producers in implementing MIG may consider converting their crop acreage to pasture. This would provide enough feed for their cattle as well as reduce their time spent on crop production. Acquiring available lands or leasing nearby lands may be another option for CONF farmers who do not have the enough land to accommodate their herd size.

Actual Challenges to Grazing: MIG versus TRAD

When compared to TRAD farmers, more MIG farmers viewed the following barriers as greater challenges: lack of information on pasture management (MIG: 35.48%, TRAD: 15.15%); lack of on-farm technical assistance (MIG: 45.16%, TRAD: 9.38%), amount of work to start pasture management (MIG: 38.71%, TRAD: 15.15%), and amount of work to manage pasture grazing (MIG: 40.00%, TRAD: 20.59%). MIG practitioners require to be efficient in farm management as well as to have the technical knowledge to make the best use of the available pastures. Additionally, MIG practitioners must have a better understanding than other farmers in regards to how much work and planning goes into adopting this kind of system. Intensive grazing systems can be employed and managed using a multitude of methods, each of which has their different requirements and benefits. So it is understandable that farmers using these practices understand the barriers more than others. With MIG based grazing, farmers must be very knowledgeable when it comes to efficiently managing their dairy herds. MIG farmers make many difficult decisions,

including choosing the best time to rotate their herd to a fresh pasture. All of the factors such as herd size, pasture size, forage availability, feed quality, and the farmer's overall ability to manage the farm efficiently play a vital role in whether or not MIG methods will be successful for the farmer. In a MIG system daily intake of forage and supplemental feed is more efficiently rationed, pasture yield is increased, the distribution of the forage is improved and the animal waste is more uniformly distributed which improves the soil quality (UGA, 2018). Hence, the optimum MIG system can provide southeastern farmers more advantages than TRAD system. In addition to all of these advantages, MIG practices can be recommended to southeastern TRAD farmers, since a greater percentage of southeastern MIG farmers were satisfied or very satisfied with their farm profit level, and the amount of time away from their farm than the TRAD farmers.

Conclusion

A mail survey was conducted targeting dairy farmers in Georgia and Florida. Analysis of the survey revealed that only 39% of the farmers used MIG practice, and there were substantial differences in how CONF, MIG, and TRAD dairy producers viewed the barriers influencing the adoption of MIG method. The study observed that more than two-thirds of CONF farmers' perceptions of decrease in milk production, decrease in farm profits, decrease in cash flow, difficulty in producing enough winter feed, and not having enough land for grazing appeared to be a challenge if they adopted rotational grazing. However, a large percentage, about 81%, of MIG practitioners did not view these as challenges. Educational programs in growing cost-effective pasture may encourage southeastern CONF farmers to adopt pasture-based systems.

The personal success in using MIG method was reflected in farmers' work satisfaction and commitments such as satisfaction with farm profit level and amount of time away from the farm compared to other methods. However, more than one third of the MIG farmers felt that lack of information on pasture management and lack of on farm technical assistance were challenges. Perhaps, further implementation of learning programs can help farmers in the southeast, and they will have an easier time transitioning into or starting their own pasture-grazed dairy farms. Additionally, more research with a larger sample from more southeastern states may produce even more compelling results on if MIG is an effective and beneficial practice for southeastern farmers.

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References

Bartlet, J. R., M. N. Jahan, D. N. O. Tackie, A. Adu-Gyamf, F. A. Quarcoo. (2016). "An Analysis of the Characteristics and Practices of Selected Alabama Small Livestock Producers: A Focus on Production and Processing." *Professional Agricultural Workers Journal* 3 (2): Article 6.

Johnson, D. M., J. C. Hanson, R. Gilker, E. Lichtenberg, and K. Minegishi. (2014). "Sustainability of Management-intensive Grazing Dairy Farms versus Conventional Confinement Dairy Farms." http://ifsa.boku.ac.at/cms/fileadmin/Proceeding2014/WS_2_7_Johnson.pdf [Retrieved February 22, 2019].

Lichtenberg, E., K. Minegishi, J. C. Hanson, and D. M. Johnson. (2011). "Economics of Intensive Grazing in Dairy Production in the Mid-Atlantic." Presented at the Agricultural and Applied Economics Association Annual Meeting, July 24-26, Pittsburgh, Pennsylvania.

O'Donoghue, E., U.Vasavada, J. MacDonald, and P. Sullivan. (2011). "Changing farming Practices Accompany Major Shifts in Farm Structure." *Amber Waves* 9 (4): 30.

Raymond, R., C. W. Bales, D. E. Bauman, D. Clemmons, R. Kleinman, D. Lanna, S. Nickerson, and K. Sejrsen. (2009). "Recombinant Bovine Somatotropin (rbST): A Safety Assessment." http://www.naiaonline.org/uploads/WhitePapers/RecombinantSomatotropinASafetyAssessment2010.pdf [Retrieved May 22, 2018].

Shook, G. E. (2006). "Major advances in determining appropriate selection goals." *Journal of Dairy Science* 89 (4): 1349–1361.

Tranel, L. (2008). "Automatic take-offs. Are they for you?" Iowa State University Fact Sheet: LT-06. Iowa State University Extension. https://www.extension.iastate.edu/dairyteam/files/page/files/Automatic TakeOffs.pdf [Retrieved May 22, 2018].

University of Georgia (UGA), College of Agricultural and Environmental Sciences. (2017). "Determining the Number of Paddocks." http://caes2.caes.uga.edu/sustainag/grazing/grazingsysdes/determpadd.html.

University of Georgia (UGA), College of Agricultural & Environmental Sciences. (2018). "Management Intensive Grazing." http://sustainagga.caes.uga.edu/systems/management-intensive-grazing.html [Retrieved February13, 2019].

USDA, National Agricultural Statistics Service. (2016). "Florida Livestock, Dairy, and Poultry Summary." https://www.nass.usda.gov/Statistics_by_State/Florida/Publications/Livestock_and_Poultry/ldpsum16/LDP16All.pdf [Retrieved October 30, 2018].

USDA, National Agricultural Statistics Service. (2017). "Milk Production." https://www.nass.usda.gov/Publications/Todays_Reports/reports/mkpr1118.pdf [Retrieved June 20, 2019].

USDA, Natural Resource Conservation Service. (2007). "Profitable Grazing-Based Dairy Systems – 2007." https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044245.pdf [Retrieved June 20, 2019].

White, S. L., G. A. Benson, S. P. Washburn, and J. T. Green. (2002). "Milk production and economic measures in confinement or pasture systems using seasonally calved Holstein and Jersey cows." *Journal of dairy science* 85 (1): 95-104.

Winsten, J. R., A. Richardson, C.D. Kerchner, A. Lichau, and J. M. Hyman. (2010). "Barriers to the adoption of management-intensive grazing among dairy farmers in the Northeastern United States." *Renewable Agriculture and Food Systems* 26 (2): 104-113.