Regional Production Differences

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ABSTRACT

The DHI records from 37 states were grouped into North, Midsouth, and South regions and six herd sizes (20 to 49, 50 to 99, 100 to 149, 150 to 249, 250 to 449, and >450 cows). Data were analyzed by region and by herd size for the year 1998. The North region had higher income over feed cost, milk, fat, and protein rolling herd averages than other regions. These variables declined for the Midsouth and were lowest for the South. Days open and somatic cell score (SCS) were lowest in the North and highest in the South. Large herds had higher total feed cost, income over feed cost, milk, fat, and protein rolling herd averages than smaller herds. For the period 1990 to 1999, the data were analyzed for the trend in change over time for each of the regions. Milk production per cow, total feed cost, income over feed cost, days open, and herd sizes increased in the period from 1990 to 1999. Somatic cell score decreased. Different rates of increments over the last decade have made differences among regions larger for milk production, total feed cost, income over feed cost, herd size, and SCS. There were no differences in the rate of change for days open. Milk production per cow and total feed cost increased at higher rates in larger herds, making the gap between these and smaller herds larger over time. Income over feed cost, days open, and herd size changes had similar rates of change during the decade, keeping differences among herd sizes constant over time. The SCS decreased at a higher rate in the smallest herds than in larger herds, making the gap between them smaller.

(**Key words:** dairy management, dairy region, dairy trends, herd size)

Abbreviation key: IOFC = income over feed cost, RHA = rolling herd averages.

INTRODUCTION

Led by market signals and availability of new technologies, the US dairy sector has been constantly

changing over time. Dairy farmers have adopted new technologies to increase dairy farm profitability. The most important changes are a reduction in the number of dairy farms and cows, an increase in the average herd size, an increase in milk produced per cow, and finally an increase in the total milk production (USDA, 1996). Differences in natural resources, cultural tradition, dairy farm structure, industry, and market have caused different regions in the United States to implement different management systems. These differences in management may be reflected in different economic and reproductive performance among regions.

Previous work (Oleggini et al., 2000) showed that dairy herd performance parameters were significantly different for regions and herd size for the year 1998. Milk production was highest, with larger herd sizes for the North region. Some authors define the herd expansion process as one of the most important factors for improving milk production per cow (Pelissier, 1968; Speicher and Nott, 1978; Norell and Appleman, 1981). The increase in milk production per cow has led to a rise in total milk production in different dairy regions (Pelissier, 1968; Brown and White, 1972; Wisconsin Agricultural Statistics Service, 1999). In the last decade, large size herds tended to increase production and reduce the cost per unit of milk, mainly as result of spreading fixed costs across more production (Bailey et al., 1997). Smith and Ely (1997a) observed that larger size herds were superior in terms of several management areas, but no single herd size was superior in all areas of management or profitability. However, the herd expansion process is not a simple change but requires the improvement in several management areas at a time including assets distribution, housing, feeding, reproduction, labor organization, and records systems. Bailey et al. (1997) explained that economies of scale on modern dairy farms are in three major areas: (1) lower investment per cow, (2) lower variable costs of production per unit, and (3) increased labor and management efficiency.

The objectives of this study were: 1) to analyze the rate of change of some management variables from 1990 to 1999, and 2) to compare this process among different regions and herds of different sizes.

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Figure 1. Region map.

MATERIALS AND METHODS

DHI herd summary records for the year 1998 were obtained from Dairy Records Management Systems, Raleigh, North Carolina. Analysis was restricted to Holstein herds with a minimum of 20 cows and 12 mo of records, resulting in 11,719 herd summary records. The 37 states analyzed were grouped in three regions: North, Midsouth, and South (Figure 1). Herds were divided into six categories based on total cow numbers as follows: 20 to 49, 50 to 99, 100 to 149, 150 to 249, 250 to 449, and >450 cows.

Data were analyzed using the general linear models procedure of SAS (1996). Least-squares means were compared among regions and herd size categories. The level of significance used was $P < 0.05$.

DHI herd summary records for the years 1990 through 1999 were obtained from the Dairy Records Management Systems, Raleigh, North Carolina. Analysis was restricted to Holstein herds with a minimum of 20 cows and at least 12 mo of records, milk production ≥ 2268 kg, total feed cost $\geq \$200$, feed cost/45.4 kg of milk $\geq \$1$, income over feed cost (IOFC) $\geq \$1$, days open ≥ 30 , % cows in milk, % cows entering the herd and % cows leaving the herd between 0 and 100, and SCS between 0 and 9. A total of 107,484 observations were sorted based upon these restrictions, resulting in 41,429 observations available for analysis.

Least-squares means were obtained for regions and herd sizes for each of the 10 yr. The least-squares means for the North region and the largest herd size in the year 1990 were not considered in the analysis due to the low number of observations in these two classes for that year. Least-squares means were graphed to observe the trend of the variables over the decade. To compare the rate of change of the variables studied among regions and herd sizes, regression coef-

Table 1. Rolling herd average milk, fat, and protein by region and herd size.

	Milk (kg/cow per yr)	Fat (kg/cow per yr)	Protein (kg/cow per yr)
Region			
North	9412.08 ^a	347.58 ^a	299.21 ^a
Midsouth	8501.15 ^b	304.61 ^b	271.99 ^b
South	7839.15 ^c	285.74 ^c	259.25 ^c
SEM	56.31	2.39	2
Herd Size			
20 to 49	8003.93	286.51	254.27 ^f
50 to 99	8164.67	292.59	261.31
100 to 149	8347.51 ^d	304.10 ^d	270.67 ^d
150 to 249	8577.73 ^c	315.41 ^c	277.68 ^c
250 to 449	8891.37 ^b	327.46 ^b	287.98 ^b
≥ 450	9519.56 ^a	349.78 ^a	308.97 ^a
SEM	76.37	3.27	2.75

ficients were calculated and tested for significant differences using the t-test method (Ott, 1993). The variables studied were: rolling herd average for milk (kg/cow per year), total feed cost (\$/cow per year), IOFC (\$/cow per year), days open, and SCS.

RESULTS AND DISCUSSION

Milk Production

Rolling herd averages (RHA) for milk, fat, and protein were significantly different among regions and herd size (Table 1). The North region was highest, and the South was lowest for all three variables. RHA milk, fat, and protein tended to decrease with decreasing herd size.

Milk production per cow increased during the 10-yr period for all the regions and herd sizes. The regression coefficients were positive and ranged from 47.12 to 97.47 per kg increases in milk per cow per year (Figures 2 and 3).

The North region had higher milk production for all years, the Midsouth region had intermediate levels, and South region had lower production. The increase in milk was not significantly different between the North and South regions, but both regions showed a significantly higher increase than the Midsouth region. Carley and Fletcher (1986) and Jones et al. (1984) observed a higher level of milk production in the North region than in the South region. Herds with 150 to 249 cows had the highest rate of increase in milk production per cow with an increase of 97.47 kg per year, which was significantly higher than herd size groups 20 to 49, 50 to 99, and 100 to 149 cows, but it was not significantly different from the two largest herd sizes (Figure 3). The increase in milk production for herd size group 250 to 449 cows (93.26 kg/year) was significantly higher than groups 50 to 99 and 100 to 149

Figure 2. Milk production per cow per year by region. Regression coefficients by region are: South ($\blacktriangle$), 81.46^a; Midsouth ($\blacksquare$), 47.12^b; and North ($\blacklozenge$) 85.29^a. Regression coefficients with the same letter are not significantly different ($P < 0.05$).

cows. Herds with 150 to 249 and 250 to 449 cows increased milk production significantly higher than herds with 50 to 99 and 100 to 149 cows. Previous studies have reported an increase in milk production as herd size increases (Miller, 1968; Pelissier, 1968; Speicher and Nott, 1978; Allore et al., 1997; Frank and Vanderlin, 1998).

Days Open

Days open increased during the 10-yr period for all regions (Figure 4) as did herd sizes (Figure 5). All the regression coefficients were positive, ranging from 4.14 to 4.72 d of increase per year.

Except for the year 1990, the South region had higher days open than the other two regions. The Mid-

Figure 3. Milk production per cow per year by herd size groups. Regression coefficients by herd size groups are: 20–49 ($\blacklozenge$), 68.56^{bc}; 50–99 ($\blacksquare$), 65.86^{cd}; 100–149 ($\blacktriangle$), 56.45^{cd}; 150–249 (X), 97.47^a; 250–449 ($\blacksquare$), 93.26^{ab}; >449 cows ($\bullet$), 84.88^{abc}. Regression coefficients with the same letter are not significantly different ($P < 0.05$).

Figure 4. Days open per year by region. Regression coefficients by region are: South (▲), 4.65^a; Midsouth (■), 4.42^a; and North (◆) 4.72^a. Regression coefficients with the same letter are not significantly different ($P < 0.05$).

Figure 5. Days open per year by herd size groups. Regression coefficients by herd size groups are: 20–49 (◆) 4.20^a; 50–99 (■), 4.29^a; 100–149 (▲) 4.34^a; 150–249 (X), 4.48^a; 250–449 (■), 4.66^a; >449 cows (●), 4.14^a. Regression coefficients with the same letter are not significantly different ($P < 0.05$).

Figure 6. Total feed cost per cow per year by region. Regression coefficients by region are: South (▲), 24.53^a; Midsouth (■), 21.11^a; and North (◆), 14.45^b. Regression coefficients with the same letter are not significantly different ($P < 0.05$).

south and North regions had intermediate and lower days open, respectively. The higher days open in the South could be one of the factors contributing to lower milk production per cow in this region. There were no significant differences in the rates of change for days open among the three regions or in the rate of change for days open among different size herds.

Total Feed Cost

Total feed cost per cow was not significantly different among regions for the year 1998. Total feed cost per cow per year increased during the 10-yr period for the different regions (Figure 6). The South region had higher increases in total feed cost per cow during the 10-yr period than the Midsouth and North regions. The rate of increase in total feed cost was significantly higher in the South Midsouth regions (\$24.53 and \$21.11, respectively) than the North region (\$14.45).

Several factors affect feed costs. Smith and Ely (1997b) observed that feeding and housing systems affect feed cost. Herds fed concentrate in the milking parlor had a lower concentrate and total feed cost than herds fed outside the parlor. In the same study, free-stall-housed herds consumed more concentrate than herds housed outside. Higher feed costs per cow for

larger herds than smaller herds were reported by Frank and Vanderlin (1997). They explained that more expensive feeding is a consequence of fewer crop acres and higher purchased feed per cow in larger herds. Miller (1968) observed that feed costs decreased when milk yield increased.

Income Over Feed Cost

Income over feed cost increased during the whole period for all the regions and herd sizes. The regression coefficients are positive, ranging from \$39.36 to \$59.78.

The North region had the highest IOFC for the 10-yr period, with the Midsouth and South regions intermediate and lower, respectively. There were significant differences in the increasing IOFC rate among the three regions, with North region having the highest, the South region the intermediate, and the Midsouth region the lowest rate. This difference in the rate of change showed that the differences in IOFC between the North region and the other two regions have been getting wider during the last 10 yr.

Somatic Cell Score

Somatic cell scores decreased in all the regions and herd sizes during the 10 yr (Figures 7 and 8). This

Figure 7. Somatic cell score per year by region. Regression coefficients by region are: South (▲), -0.013^b ; Midsouth (■), -0.005^b ; and North (◆), -0.058^a . Regression coefficients with the same letter are not significantly different ($P < 0.05$).

decrease contributed to an increase in milk production per cow. Somatic cell score is an indicator of milk quality and udder health, and milk yield decreases with increasing SCS (Jones et al., 1984; Van Horn and Wilcox, 1992). Except for the year 1991, the South region had a higher SCS than the other two regions. Similar results by Miller et al. (1999) suggested that higher temperatures in the South could be an important factor for the higher SCS. The rate of change of SCS was significantly higher in the North region than in the Midsouth and South regions (Figure 7). There was no significant difference between these last two regions. The greater rate of decline in the North region may be partially due to the introduction of quality premiums in the region during this time period. This provides an economic incentive to lower SCC in addition to a potential increase in milk production.

Herds with >449 cows had lower SCS than all other groups during the entire period except for the year 1999 (Figure 8). The declining rate of change in the SCS for herds with 20 to 49 cows was significantly

greater than for all other groups. Herds with 50 to 99 cows had a significantly greater declining rate than herds with 100 to 149 and >449 cows. Herds with >449 cows had a lower declining rate than the three smallest herd size groups. The declining rate of change in SCS was greater for smaller herds, making the differences between large and small herds less over the decade. Khaitisa et al. (1998) observed that herd size, premilking dipping, postmilking dipping, and the use of selective dry cow therapy affected mastitis significantly.

CONCLUSIONS

Milk production per cow, total feed cost, IOFC, days open, and herd size increased for all regions and herd sizes over the period from 1990 to 1999. SCS decreased during the 10 yr period.

The South region had lower milk production than the other regions but had the same rate of increase in milk production as the North region. The South region had lower IOFC and the highest rate of increase for

feed costs. Days open was the highest for the South region, but the rate of change was not different from the other regions. SCS was higher in the South than the other regions.

The performance in the South region is probably partially due to the environmental effects of heat stress.

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Figure 8. Somatic cell score per year by herd size group. Regression coefficients by herd size group are: 20–49 (♦), 0.05^a; 50–99 (■), –0.04^b; 100–149 (▲), –0.02^{cd}; 150–249 (X), –0.03^{bd}; 250–449 (■), 0.03^{bc}; and >449 cows (●), –0.01^d. Regression coefficients with the same letter are not significantly different ($P < 0.05$).