EFFECT OF SEASON ON BEEF CATTLE PERFORMANCE AND PROFITABILITY

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Abstract

Purpose of this study was to determine effect of season on beef cattle performance and profitability in beef cattle farms in Afyon province. Data were obtained by conducting a questionnaire with 100 beef cattle farms selected by stratified random sampling method. Starting date on feed was assigned to seasons and, since the steers were fed an average for 202 days, an overlapping of seasons occurred. Thus, cattle started on feed in spring, autumn, summer and winter were finished in summer, spring, autumn and spring, respectively. Cattle started in spring, autumn, summer and winter were exposed to hot, cold and warm portions of the year, respectively, and were classified as hot, cold and warm season cattle. Cattle raised in cold season had lower average daily gain (ADG) than those in warm season ($P<0.05$). Feed efficiency of cattle raised in warm and hot season was better than those raised in winter ($P<0.05$). It was found that cattle raised in cold season had higher cost for 1 kg of liveweight, liveweight gain and carcass than other seasons ($P<0.05$). Gross profit, net profit and relative return of cattle raised in cold season was lower than other seasons ($P<0.05$). When average profit of all farms were considered, it was found that profit was not enough to sustain a farm household's living. In the study area cost and sale price of 1 kg carcass were close to each other thus discrepancy between these two prices defined as profit margin was small.

Key words: beef cattle, season, performance, cost, profitability.

INTRODUCTION

Beef cattle production is an important branch of animal production sector and has had a special place in Turkish economy with its employment rate and values of products produced. According to data from year 2005, share of beef in total read meat production was 53.50 %. However in recent years a decrease in total cattle population, and beef production has been observed. With a 17.28 percent decrease, cattle number in Turkey went down from 12 173 000 in 1990 to 10 069 346 in 2005. As a result of this between years 1990-2005 even though there was a 51.69 % increase in carcass weight, red meat production decreased from 742 149 to 685 900 ton/year corresponding to 7.58 % decrease (FAO, 2005). Decrease in number of cattle stems from different factors such as high beef production costs, lower carcass prices and these factors resulted in closure of some farms.

Beef cattle production in Afyon is an important branch of agriculture is ranked third in terms of beef cattle production in Turkey. According to data obtained for 2002, read meat production in Afyon was 19 118 ton and 96 percent of this meat consisted of beef. Total number of cattle in Afyon is 210 043 heads and 76 percent of this population is European breeds (Anonymous, 2002). Afyon is located at the intersections of adjacent provinces' roads and markets beef products to these provinces. Thus industry based on beef production is established and developed in Afyon (Anonymous, 1996).

Profitability is a key component in sustainability of beef cattle farms. In order to increase profitability of beef production, production efficiency and marketing time should be considered. Season is one of the important factors affecting performance and profitability of beef cattle (Koknaroglu et al., 2005a; Koknaroglu et al. 2005b)

Purpose of this study was to analyze effect of season on performance and profitability of beef cattle in Afyon province that is an important center for beef production in Turkey. In the study, performance and carcass characteristics of cattle, cost of production, cost for production of 1 kg liveweight, liveweight gain, carcass, gross profit, net profit, proportional profit were determined for seasons, determination of profitable season was done and suggestions for increasing performance of cattle and profitable farming were given.

MATERIALS AND METHODS

Data consisted of primary information obtained by questionnaire from beef cattle farms in Afyon province, Bolvadin, Şuhut, Çay, Dinar, Sinanpaşa and İhsaniye districts and villages in these districts. Along with data obtained by questionnaire, similar studies conducted by other institutions and researchers were also utilized. Data consisted of information obtained for 2005 year. Regarding to personal communication with personnel in branch of Ministry of Agriculture in Afyon, 23 villages in Afyon province, Bolvadin, Şuhut, Çay, Dinar, Sinanpaşa and İhsaniye districts that were involved intensively in beef cattle farming were chosen for employing questionnaire. Beef cattle farms in these villages that meet research criteria constituted population size. Districts chosen for research purpose constituted 81.7 % of beef cattle population in Afyon province (Anonymous, 2004) and thus sample size represents population size. Neyman method of stratified random sampling method was conducted to select number of beef cattle farms for questionnaire

(Yamane, 1967). Sampling size was determined by using equation

1.

$$n = \frac{\left(\sum N_h S_h\right)^2}{N^2 * D^2 + \sum N_h S_h^2} = \frac{3333.13^2}{1132096 * 0.0932 + 15976.40} = 91$$

(1)

where;

n: sampling size
N_h; number of farms in h^{th} group
S_h; standard deviation of h^{th} group
S_h^2; variance of h^{th} group
N; population size
D^2; is $(d/z)^2$ where d is deviation (5%) from mean (X=11.97), z is standard normal distribution value (1.96) that corresponds to 95 % probability.

$$D^2 = \left(\frac{d}{z}\right)^2 = \left(\frac{\overline{X} * 0.05}{1.96}\right)^2 = \left(\frac{11.97 * 0.05}{1.96}\right)^2 = 0.0932$$

(2)

Using above Equation 1, sampling size that would represent population was found to be 91. However taking into account some questionnaires would not be qualified for analyses, 104 beef cattle farms randomly chosen to conduct questionnaire. Of the 104 farms 4 had misinformation and did not qualify for analyses, thus 100 farms were used for study. Farms that questionnaire conducted were randomly chosen. Since there were differences in cattle population among farms, establishment of groups were decided to homogenize population. Considering animal population of farms and frequency distribution, farms were divided into three groups. In distributing farms to groups equation 3 was used (Yamane, 1967).

$$n_h = \frac{N_h S_h}{\sum N_h S_h} * n \qquad (3)$$

where;

n_h; is sampling size for each group
n; sampling size
Distribution of population by groups and number of farms by groups are given in Table 1.
Among farms regarding their size, farms were divided into three groups:
Group I: farms that have 5-10 animals (33 farms)
Group II: farms that have 11-25 animals (41 farms)
Group III: farms that have more than 25 animals (26 farms).

Depreciation for building, machinery and animal was calculated. Depreciation rates were 2, 4, 1.5, 5, and 25 % for concrete buildings, mud brick and wood buildings, stone buildings, capital for machinery, and small tools, respectively (Erkus et al. 1995; Sayılı and Esengün, 2002).
Since end of the year value (worth) were considered for machinery, building and cow capital, real interest rates were used (Kadlec 1985):

$$i = \frac{1 + r}{1 + f} - 1$$

(4)

Where:
i : real interest rate
r : nominal interest rate
f : inflation rate (wholesale price index)

In period during which questionnaire was conducted, annual nominal interest was 14 % and inflation rate was 4.26 % and thus real interest rate was found to be as 9.3 %. Since some farms in the sample have both crop production and beef cattle, fixed and some variable costs for machinery were common costs for those production branches. The distribution of common cost between crop production and beef cattle branch was evaluated based on machinery use ratio between beef cattle and crop production. Management expense was assumed to be 3 % of variable costs. When calculating equivalence of labor cost for family work, wage rate for hired worker was taken as base (Kıral et al., 1999). Production cost is spread throughout the feeding period, thus interest rate for production cost throughout the feeding period should be considered. This interest is called revolving fund interest and reflects the opportunity cost of capital invested for production. Revolving fund interest was taken as half the interest rate (9 %) applied by Turkish Republic Agricultural Bank to variable costs for beef cattle production credits (Sayılı and Esengün, 2002).
Equations 5, 6, 7 were used to calculate production cost for 1 kg of liveweight, liveweight gain and carcass, respectively (Kıral et al. 1999).
Revenue from carcass and manure sale constituted gross product value. By subtracting variable costs and production cost from gross product value gross profit and net profit were obtained respectively. Relative return was calculated by dividing gross product value to total production costs (Rehber 1993; Erkuş et. al. 1995).

STATISTICAL ANALYSIS

Number of farms selected for farm sizes were analyzed to determine effect of season on beef cattle performance and profitability. Accordingly, starting time on feed

$$\text{Production cost for 1 kg liveweight} \quad \frac{\text{Total production cost including cattle purchase price} \quad \text{manure sale}}{\text{Final weight kg}} \tag{5}$$

$$\text{Production cost for 1 kg liveweight gain} \quad \frac{\text{Total production cost excluding cattle purchase price} \quad \text{manure sale}}{\text{Liveweight gain kg}} \tag{6}$$

$$\text{Production cost for 1 kg carcass} \quad \frac{\text{Total production cost including cattle purchase price} \quad \text{manure sale}}{\text{Carcass weight kg}} \tag{7}$$

was used for assignment to seasons, and seasons were classified as Winter (December to February), Spring (March to May), Summer (June to August) and Autumn (September to November). Since cattle were fed for an average of 202 days, overlapping of seasons occurred and cattle starting in the feedlots in spring were finished at the end of summer. They were exposed to the hotter part of the year, which was classified as "hot season". Cattle started in autumn were finished at the end of spring and were exposed to the colder part of the year. This group was classified as "cold season". Cattle which started in winter and in summer were finished at the end of spring and autumn, respectively, and the parts of the year they were exposed to were intermediate in terms of temperature. These two periods were classified as the "warm season". Among 100 farms, 41, 30 and 29 farms were included in warm, hot and cold season, respectively. Data obtained were analyzed with SAS programs. Season was used as independent variable whereas performance, cost and profit parameters were used as dependent variables in SAS program. PDIFF statement in SAS (1999) was used to compare significance levels of means. Alpha level of 0.05 was chosen as significance level. Performance, carcass and economics variables are reported for a head of cattle.

RESULTS AND DISCUSSION

Performance and carcass characteristics for cattle by season are provided in Table 2.

Cattle raised during warm season had longest time whereas those fed during hot season had shortest time on feed. Cattle fed during warm season had heaviest and those fed during cold season had lightest initial weight. Cattle fed during warm season had highest final weight and this was different from those fed during hot and cold seasons ($P<0.05$). This could be expected since cattle fed during warm season had both higher initial weight, higher average daily gain (ADG) and longer time in feedlot (Table 2). Dry matter intake (DMI) did not differ among seasons however cattle fed in cold season had numerically higher DMI. Koknaroglu et al. (2005a) found that cattle fed in cold season had higher DMI than in other seasons. In cold environments with ambient temperature below beef cattle's lower critical temperature, an animal has to increase its energy intake to maintain proper function of the body. This increase is a result of an increase in metabolic heat production in order to compensate for a greater heat loss due to falling ambient temperature. Consequently, increases in energy requirements result generally in an increased appetite, thus in greater feed intake. Shijimaya et al. (1986) reported that dairy cattle housed in cold barns in which the daily mean temperatures were -5.5 °C to 1.5 °C, had higher dry matter intakes than cattle housed in warm barns in which the daily mean temperatures were 8.2 to 11.2 °C. However, at extremely low ambient temperatures disruption of feeding behavior is observed in cattle (Forbes, 1986; Young, 1988). Cattle fed during hot season had lower DMI due to depressing effect of heat on feed intake. Somanathan and Rajagopalan (1984) found that the percentage dry matter intake was the lowest during the months when the ambient temperature was the highest. Therefore, they assumed that the higher ambient temperature had a depressing effect on the dry matter intake. Koknaroglu et al. (2006) also found that in Iowa, depressive effect of heat was displayed in August for cattle fed in open lot, open lot with access to an overhead shelter and in confinement housing Upper critical temperatures for most traits and most species fall between 23.4 and 27.2 °C and vary depending on degree of acclimatization, rate of growth or production, air movement around the animals and relative humidity (Fuquay, 1981). Heat stressed animals reduce intake while their maintenance requirement is increased, which leads to reduced performance.

Average daily gain (ADG) of cattle fed during warm season was higher than that of cold season ($P<0.05$). Cattle fed during hot season was intermediate in terms of ADG and did not differ from other seasons ($P>0.05$). As a rule of thermodynamics the performance of cattle depends on how much energy they consume and how much energy they spend for maintenance. Cattle as a homeotherm animal live in a dynamic environment and interact with it (Hahn 1999). The environment surrounding cattle often dictates their maintenance energy requirement and their feed intake (Delfino and Mathison 1991). In winter when feedlot cattle are exposed to adverse environments, the maintenance requirement increases with less energy available for production. Research showed that when finishing steers exposed to different magnitudes (degrees below lower critical temperature) of coldness, NE_m increased with decreasing temperature and NE_g gradually decreased with decreasing temperature (Ames, 1987).

Feed efficiency (FE) of cattle fed in different seasons is given in Table 2. Cattle fed during warm and hot season had better FE than those fed during winter

(P<0.05). Even though cattle fed during warm season had better FE, this was not different from those fed during hot season (P>0.05). The reason for cattle fed during cold season is association between temperature and digestibility of feed. Extensive data from several experiments showed that digestibility for ruminants decreases by an average of 0.2 % for each 1 °C decrease in ambient temperature (NRC, 1981). In a study with cattle and sheep exposed to natural winter conditions or subjected to prolonged exposure in climatic chambers in Canada, Christopherson (1976) found that the decrease in dry matter digestibility per degree decrease in temperature was; 0.31% per 1 °C for sheeps, 0.21% per 1 °C for calves and 0.08% per 1 °C for steers. Thus suggesting that the digestive function in younger, smaller animals may be more markedly influenced by environmental temperature than that of older, larger animals. The influence of cold on digestive function is probably effected by an increase in gut motility and higher passage rate, thus shortening the exposure time of digesta with microbial degradation (Young, 1981). Milligan and Christison (1974) found that average daily gain and feed efficiency were significantly related with mean ambient temperature. Correlation coefficients for days below -30.6 °C were -0.74 and 0.86 for average daily gain and feed efficiency, respectively. Another reason for cattle fed during cold season not to have good feed efficiency was that producers raising cattle in confinement buildings were not providing adequate ventilation that removes excess gases, humidity in the house. Koknaroglu et al. (2006) found that temperature-humidity index was one of the main factors affecting DMI of cattle raised in confinement.

Carcass weight and dressing percentage are given in Table 2. Carcass weight and dressing percentage of cattle fed during warm season was higher than that of hot and cold (P<0.05). Carcass weight is a function of final weight and dressing percentage. Thus heavier cattle with higher dressing percentage would have higher carcass weight. When cattle were sold, cattle fed in cold and hot season were lighter and were expected to be younger, thus they were assumed to have formed skeletal system and visceral organs and started developing muscle and depositing fat whereas cattle fed in warm season were heavier and had developed muscles. Thus these cattle had higher dressing percentage.

Production cost for 1 kg of liveweight, liveweight gain and carcass are provided in Table 3. Cattle fed during warm and hot season had lower production cost for 1 kg of liveweight, liveweight gain and carcass than cattle fed during cold season (P<0.05). Cattle fed during cold season had higher production cost for 1 kg liveweight, liveweightgain and carcass due to their lower final and carcass weight, and on the other hand relatively high production costs. Similar results were obtained by Koknaroglu et al. (2005b) who found that cattle started on feed in fall and fed during cold season tended to have higher production cost for 1 kg of liveweight gain than those fed during warm and hot season.

Gross product values for seasons are given in Table 4. Gross product value is summation of income from carcass and manure sale values and it was highest and lowest for cattle fed during warm and cold season, respectively (P<0.05).

Production cost for seasons are provided in Table 4. Even though cattle fed during warm season and in cold season had numerically higher and lower production costs, respectively, this was not different (P>0.05). Variable cost was the main contributor of production cost. Proportion of variable cost in total production cost was 87.36, 86.81 and 86.61 % for warm, hot and cold seasons respectively, whereas fixed cost was 12.64, 13.19, 13.39 % for warm, hot and cold seasons respectively. Similar results were found by Özkan and Erkuş (2003) who analyzed farm economics by farm sizes and found that variable and fixed cost constituted 86.7 and 13.3 % of total cost, respectively. Reason why variable cost had a high share in total cost was animal purchase and feed cost. Proportion of animal purchase and feed cost in total cost was 72.89, 72.48 and 73.21 % for warm, hot and cold seasons respectively. Similar results were obtained by Özkan and Erkuş (2003), Polat (1997) and Sakarya and Günlü (1996). In order to decrease feed cost, good quality forages at a relatively low price should be used as roughage source in ration and ration preparation techniques should be applied by farmers.

Gross profit, net profit and relative return for seasons are given in Table 4. Gross profit is an important criteria that determines competitive edge of the production activity of the farm in terms of insufficient resources use. In another word, gross profit is a criteria that shows the success of the enterprise (Erkuş et al. 1995).

Gross profit for seasons was 488.59, 464.58 and 35.13 for warm, hot and cold seasons respectively (Table 4). Net profit for seasons was 193.61, 196.95 and -270.48 for warm, hot and cold seasons respectively (Table 4). Gross and net profit of cattle fed during cold season was lower than those fed during warm and hot season (P<0.05). Relative return is another criteria that measures the success of a farm enterprise. Relative return shows return obtained for every 1 unit invested. Thus values lower than 1 means that total production cost exceeds gross product value leading a loss. If this value is larger than 1, this indicates that this enterprice is profitable. In this study relative return was 1.08, 1.10 and 0.88 for warm, hot and cold seasons respectively (Table 4). Relative return of cattle fed during cold season was lower than those fed during warm and hot season (P<0.05).

It was found that in the research area cattle fed during warm and cold season were more profitable. However, average income of all farms was not enough to sustain a farm household. Thus in the research area extension services that have positive impacts on performance of cattle should be developed. In addition, policies that decrease feed costs and that increase farm income by subsidy for forage cultivation should be applied. In order to promote cattle husbandry, subsidies should be given to farmers who raise cattle and provide hygienic and healthy meat, processed by controlled slaughter houses.

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Received for publication on June 29,2006
Accepted for publication on March 15,2007

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