



QUICK RESPONSE REPORT

Emergency Responses for High Plains Cattle Affected by the December 28-31, 2006, Blizzard

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The views expressed in the report are those of the authors and not necessarily those of the Natural Hazards Center or the University of Colorado.

Abstract

Parts of five states in the Great Plains region of the United States experienced severe winter storms in late December 2006. Though blizzards can affect society in many ways, the primary purpose of this research was to determine the effect of the severe winter weather on the cattle industry in the region. In order to complete this study, three counties from Colorado (Kit Carson, Lincoln, and Kiowa) and four counties from Kansas (Sherman, Thomas, Greeley, and Hamilton) were used. Sixty-two surveys were completed, providing information on the problems cattle ranchers and farmers had to deal with, the effectiveness of the response to the blizzard, and what ranchers hope to see in the future in terms of disaster relief. The results of this research should assist local and state disaster managers in the response, recovery, and rescue operations of future blizzards in the study area and elsewhere.

Introduction

Parts of five states (Colorado, Kansas, Nebraska, New Mexico, and Oklahoma) of the Great Plains region of the United States experienced severe winter storms on December 28-31, 2006. The amount of snow that fell during these storms ranged from 58 inches in New Mexico to 16 inches in Nebraska. The storm affected five states that also experienced blizzards a week earlier, on December 18-22, 2006. In addition to heavy snow, freezing rain during the storms of December 28-31, 2006, led to significant ice accumulation. The ice resulted in tens of thousands of people in the affected states losing electrical power, thus virtually paralyzing much of the Great Plains.¹ Ice accumulation also downed trees and communication towers.

The worst victims of the December storms, particularly in the High Plains, were cattle; thousands were trapped by heavy snow and strong winds, which created drifts up to 20 feet in some areas. The deep snow and drifts made it difficult, if not impossible, to get to cattle for several days. A considerable proportion of cattle producers had feed bales

in the field that they could not reach because of the snow depth and the drifts. The storm covered more than half of the nation's major cattle-feeding area. According to the Colorado Division of Emergency Management, there were approximately 350,000 cattle in the region at immediate risk due to the storms.

In order to save livestock herds snowed in by back-to-back holiday blizzards, small helicopters and large cargo planes were dispatched to spot cattle and drop hay bales for those that had gone without feed for days. In Kansas, for example, the Kansas National Guard dropped hay in Cheyenne and Greeley counties. About 42,000 pounds of hay were dropped by the Kansas National Guard in the latter county. Unfortunately, some hay had high nitrate levels, which affected the animals already under physiological stress (i.e., sick, hungry, and pregnant) and made them more susceptible to nitrate toxicity. Colorado helicopters, as well as helicopters brought in from Oklahoma and Wyoming, began flight missions in Baca and Bent counties in Colorado (Sorensen 2007). Despite these efforts, an undetermined number of livestock died because of the bliz-

zard. Up to 15,000 range and feedlot cattle may have been killed in Colorado alone.

Along with the cattle, farmers, ranchers, and other rural residents of the Great Plains also suffered and experienced damage from these winter storms. Emergency crews, state National Guards, and state highway patrols worked extended shifts through the holiday weekend to evacuate people with health problems, deliver food and medicine to the region's snowbound residents, and open roads. In Colorado, the National Guard dropped emergency supplies, such as meals ready to eat, medicine, and baby formula, just outside people's homes so they could reach the bundles.

Utility workers worked around the clock for more than a week to restore electricity to more than 80,000 homes and businesses in the affected counties. With phone lines down across much of the region and rural roads largely impassible, some residents were trapped. Ice and heavy snow also bent over electric towers and downed hundreds of miles of power lines. The storm was also blamed for at least 13 deaths.

President Bush declared 114 blizzard-affected counties as disaster areas, including 13 in Colorado, 44 in Kansas, and 57 in Nebraska, clearing the way for federal support to help the states recover from

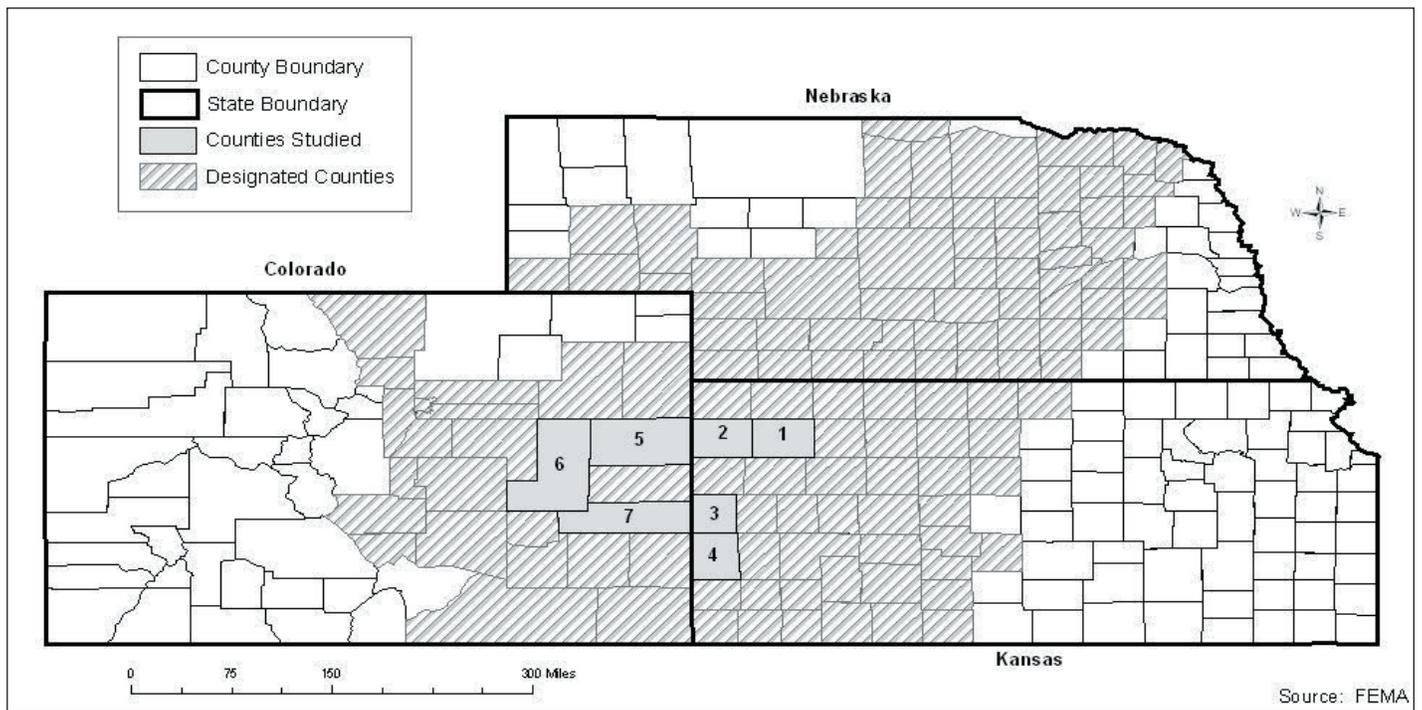
the December 2006 winter storms (Figure 1). Federal funds were available to state and local governments and some nonprofit organizations in the affected counties and cities for debris removal, road clearance, and other emergency services.

Objectives

On average, the United States experiences about 11 blizzards per year. Each blizzard causes property and crop damages of around \$52 million and approximately \$3 million, respectively. Mitchell and Thomas (2001) reported that the average damage caused by blizzards from 1975 to 1998 was \$830 million per year. Blizzards affect an average of 26 million people per winter season and the major population impacts per blizzard occur in the populated areas of the U.S. Midwest and Northeast (see Schwartz 2004). Despite a major disruption to community activities, among all weather-related disasters, blizzards have received little or no attention from hazard researchers. Most available studies (e.g., Schwartz and Schmidlin 2002) are concerned either with physical aspects of blizzards or societal impacts of these extreme events (e.g., Schwartz 2004, Schwartz and Schmidlin 2002).

The specific objectives of this research are to examine the experiences of people affected by the

Figure 1. Study area



1 – Thomas County 2 – Sherman County 3 – Greeley County 4 – Hamilton County 5 – Kit Carson County
6 – Lincoln County 7 – Kiowa County

blizzard of December 28-31, 2006, and to explore the nature and extent of public and private emergency response and relief efforts undertaken to save and rescue cattle in selected rural counties of Colorado and Kansas. Other relevant information, such as blizzard-induced property damage, cattle losses, and residents' sheltering arrangements during the blizzard are also explored, along with residents' level of satisfaction with response efforts extended to them and their cattle.

Direct and Indirect Impacts of Blizzards on Cattle

The blizzard had severe effects on the cattle industry that will be felt for years to come. Like other weather-related disasters, severe winter storms—widely termed as blizzards—cause disruptions to transportation; damage to crops and buildings; closure of schools, businesses, and roads/trails; and breakdown of public utilities such as communication, electricity, and heat (Helburn 1982; Mitchell and Thomas 2001; Schwartz 2004).² Blizzards cause many other problems, such as childbirth complications and heart attacks. In fact, heart attacks suffered while shoveling snow are the number one cause of death during a blizzard. Blizzards make it extremely difficult to obtain necessary medical supplies, food, and other sources of sustenance (Chapman 1999, Perry et al. 1996). During blizzards it can be difficult to see or breathe. Blizzards can kill people, cause traffic accidents, and bring life to a halt.

Blizzards can also cause cattle deaths. In a blizzard, cattle try to face away from the wind and move with the storm (Cotton and Ackerman 2007). They also herd together, creating a windbreak. Snow piles up on cattle, eventually covering and suffocating them. This, in turn, can cause cattle to die. Blizzards create a number of health problems for the cattle, including hypothermia, frostbite, and trauma (CEAH 2002).³ The loss due to health problems may actually eclipse the loss from cattle deaths. Health problems intensify for those cattle that stay in open fields in bitter cold without feed and water for days. This causes malnutrition and under-nutrition, which, in turn, reduces cattle weights and causes economic losses. Because of the moisture and cold, feed goes toward maintaining animals, rather than toward weight gain. For instance, the estimated losses for a rancher with 4,000 head of cattle that are “off” by 150 pounds each total \$550,000 (at \$0.92 per pound).

Blizzards often force dairy farmers to dump milk because of transportation problems. Moreover,

continued snow cover will require additional feed and supplemental nutrition costs not typically budgeted. The wet, cold conditions in the muddy corrals can also lead to conditions like frozen feet/foot rot and pneumonia. Such health problems increase veterinary expenses for ranchers. Cows that are in advanced stages of their pregnancy during blizzards often experience spontaneous abortions and still births. Farmers and ranchers use more fuel to clear the snow and pay extra wages for their workers. Generally, the indirect economic impact of blizzards on cattle is greater than the direct economic impact (CEAH 2002).

Research Design

Data Collection Procedures

Although 114 counties across Colorado, Kansas, and Nebraska were declared as federal disaster areas, cattle in the first two states were at highest risk from the December 28-31, 2006, blizzard. For this reason, these two states (Colorado and Kansas) were selected as the study area for this research. Considering the limited resources and time constraints, only seven of the 57 affected counties of Colorado and Kansas were purposely selected. Four counties were selected from Kansas. Two of these counties (Sherman and Thomas) are located along I-70, while the other two (Greeley and Hamilton) are away from I-70. Three counties were selected from Colorado – two (Kit Carson and Lincoln) are located along I-70 and one (Kiowa) is distant from the highway (Figure 1).⁴ Such a selection was made with the assumption that the emergency response and relief efforts would differ between isolated (away from I-70) and non-isolated (along I-70) counties because of differences in physical accessibility. Additionally, isolated counties were more severely affected by the December 28-31, 2006 blizzard than the non-isolated counties.

The initial plan was the conduct face-to-face interviews with ranchers and farmers of the selected counties in Colorado and Kansas. Large-scale commercial feedlot operations were deliberately excluded from this study. It was evident from first trip to the field that other methods of data collection were needed to accomplish the objectives of this study; because of heavy snow accumulations, it was not possible to use county and other access roads to reach the potential respondents. Several county agricultural extension officials also discouraged conducting in-person interviews. They informed the research team that they had ready access to most

blizzard victims, and that they were willing to give names and phone numbers for some ranchers. For other victims, the officials mailed the survey instrument directly to the ranchers.⁵ As a result, multiple survey methods (mail, phone, and in-person questionnaire surveys) were used to collect information from blizzard victims.

As indicated, respondents of this study might best be described as a “sample of convenience” rather than as a random sample. Despite this, the results of this study are highly suggestive and significant in their own right and useful as a source of further research. Relevant information was also collected from secondary sources such as the state and county emergency management agencies and agricultural extension offices. Three members of field survey team also attended a livestock auction held in Oakley, Kansas, on February 17, 2007, in order to meet ranchers affected by the blizzards and collect relevant information from them.

The structured questionnaire used to collect information from the ranchers and farmers included two broad sections. In the first section, information was collected on the blizzard that occurred on December 28-31, 2006, and its various impacts, including those on the cattle population. Several questions were included in this section to seek the ranchers’ and farmers’ opinions regarding their level of satisfaction with emergency supplies provided by external sources for their families and cattle. A 1-5 Likert scale, where 1 signifies highly dissatisfied and 5 highly satisfied, was used. A score of 3 infers the respondent is neither particularly dissatisfied nor satisfied. In the second section, respondents were asked to provide ancillary information regarding household and individual characteristics such as gender, age, and marital and employment status.

Analysis of field data was completed using frequencies, percentages, and relevant descriptive statistics. The chi-square statistic was used to test for differences between respondent charac-

teristics and their responses, which are dichotomized as isolated and non-isolated counties.

Characteristics of the Respondents

Although the initial plan was to interview approximately 100 blizzard victims from the selected counties of Colorado and Kansas, it was possible to collect information from 62 victims: 32 from non-isolated counties and 30 from isolated counties. The

Table 1. Selected characteristics of the respondents.

Characteristics	Non-Isolated Counties Number (%) (n=32)	Isolated Counties Number (%) (n=30)	Total Number (%) (n=62)
Gender			
Male	27 (84.38)	22 (73.33)	49 (79.03)
Female	5 (15.62)	8 (26.67)	13 (20.97)
<i>Chi-square=1.139 (d.f.=1; p=0.286)</i>			
Marital Status*			
Married	29 (90.63)	29 (96.67)	58 (93.55)
Divorced	3 (9.37)	-	3 (4.84)
Widowed	-	1 (3.33)	1 (1.61)
Age (in years)**			
25-36	3 (9.38)	3 (10.00)	6 (9.68)
37-55	22 (68.75)	15 (50.00)	37 (59.68)
56-64	6 (18.75)	7 (23.33)	13 (20.97)
>64	1 (3.12)	5 (16.67)	6 (9.67)
<i>Chi-square=2.393 (d.f.=1; p=0.122)</i>			
Education**			
Grade School	2 (6.25)	1 (3.33)	3 (4.84)
High School	2 (6.25)	2 (6.67)	4 (6.45)
Some College	13 (40.62)	21 (70.00)	34 (54.84)
Undergraduate	12 (37.50)	4 (13.33)	16 (25.81)
Graduate	3 (9.38)	2 (6.67)	5 (8.06)
<i>Chi-square=5.824 (d.f.=2; p=0.054)</i>			
Income**			
<\$20,000	2 (6.25)	2 (6.67)	4 (6.45)
\$20,000-39,999	7 (21.88)	6 (20.00)	13 (20.97)
\$40,000-59,999	5 (15.62)	13 (43.32)	18 (29.04)
\$60,000-99,999	8 (25.00)	2 (6.67)	10 (16.13)
>\$99,999	6 (18.75)	5 (16.67)	11 (17.74)
No response	4 (12.50)	2 (6.67)	6 (9.67)
<i>Chi-square=5.948 (d.f.=2; p=0.051)</i>			

* No Chi-square statistic is calculated because in more than 25% of the cases, the cell frequency was <5.

** For age, education, and income, the first two and last two categories are merged in order to calculate the Chi-square value.

research team only received the names and phone numbers of three operators in Thomas County, and thus, the number of survey respondents was correspondingly small. A controversy in neighboring Logan County over a rancher's desire to maintain a prairie dog colony, and thus his opposition to a county program to poison them, may have affected access to ranchers and farmers of Thomas County. This controversy, which has been covered in *The New York Times*, has led to suspicion of outsiders that locals think may sympathize with animal rights concerns.

Table 1 presents selected demographic and socio-economic characteristics of the respondents by the two types of counties considered in this study. The table shows that an overwhelming majority of the respondents were male (79%). This was not unexpected since farming and ranching are male-dominated occupations. Over 93% of all respondents were married at the time of the questionnaire survey (Table 1). Only about 5% of the respondents were divorced. The divorce rate is generally lower in rural areas than in urban areas.

Nearly 10% of all respondents belonged to the 25-36 years of age group. A similar proportion of respondents belonged to the over 64 years of age group. This means that the remaining 80% were between the ages of 37-64. Cattle-raising requires hard work. It is likely that younger and older rural residents are less interested in this occupation. Older residents may have also retired or sold their holdings, while younger ones may not have the resources to secure land and cattle. The questionnaire survey reveals that all respondents were employed full time as either farmers or ranchers.

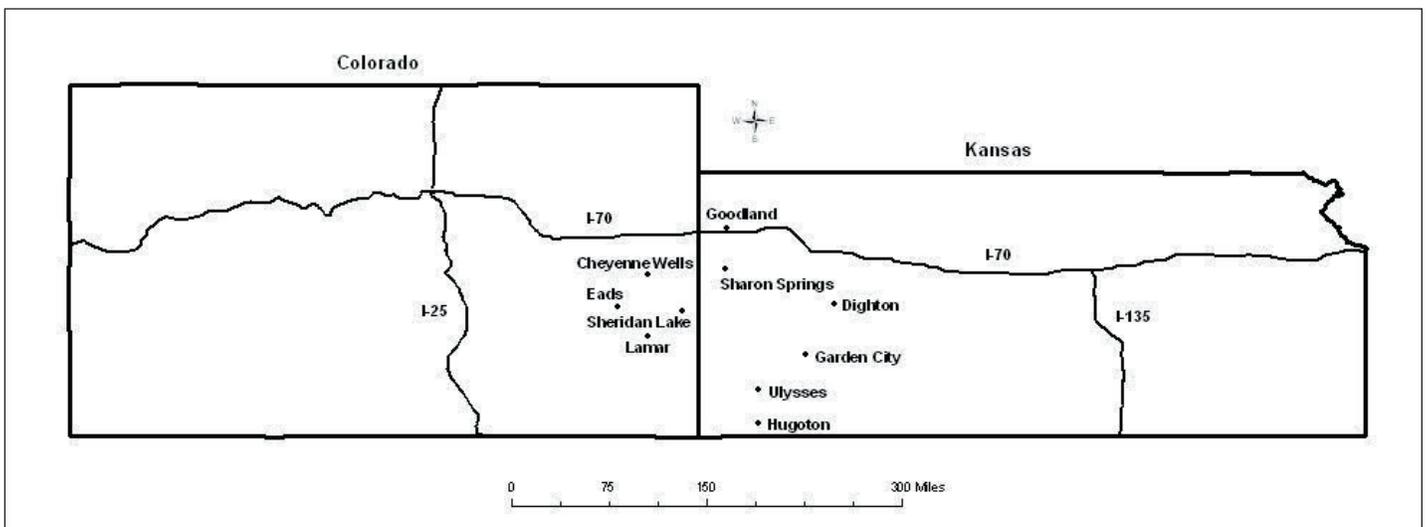
As shown in Table 1, the level of education of the respondents is categorized into five classes. Nearly 55% of all respondents attended some college, but did not receive any college degree. Nearly 34% of all respondents received undergraduate and graduate degrees. This percentage seems high for respondents in rural areas. It is, however, evident from the income data presented in Table 1 that the majority of the respondents reported a yearly household income higher than \$39,999. This suggests that cattle-raising is a profitable enterprise and relatively educated people are also engaged in this occupation. Six respondents (10%) did not provide information on household income.

The information presented in Table 1 suggests that the selected demographic and socio-economic characteristics of the respondents do not significantly differ between the two types of counties considered in this study. The calculated chi-square values are not statistically significant. Educational level of the respondents and annual household income barely miss the 5% significance level. This means that respondents of the non-isolated and isolated counties were drawn from the same population.

Results

The blizzard that occurred December 28-31, 2006, dropped 44 inches of snow in some parts of southeastern Colorado and as much as 32 inches in western Kansas. Twenty to 30 inches of snowfall accumulated in the Lamar, Eads, Cheyenne Wells, and Sheridan Lake areas of southeastern and far east-central Colorado. In Kansas, Sharon Springs, located south of Goodland, received around 30 inches of snowfall (Figure 2). Strong north winds caused un-

Figure 2. Selected cities in Colorado and Kansas



believable blizzard conditions, with drifts as tall as two-story buildings. In addition, two to three inches of ice accumulated in some parts of southwestern Kansas and eastern Colorado, causing significant damage to trees, utility poles, and power lines. The worst ice accumulation occurred along a corridor stretching from Hugoton to Ulysses and Dighton to Garden City in southwest Kansas (Figure 2). In western Kansas, as many as 10,500 utility poles were reported down, and muddy road conditions were slowing down replacement activities (FEMA 2007).

Respondents' Blizzard Experience

The questionnaire survey data reveal that two-thirds (41 out of 62) of all respondents did not experience any power loss at their homes during the blizzard. The remaining one-third of the survey respondents had to stay in their homes without power for from a few hours to nine days. On average, these respondents were without power for two days. Although 46 (74%) respondents owned a generator, only 14 respondents had to use it. A careful examination of the survey data showed that more than half of the respondents who owned a generator during the time of blizzard did not use it because they had electricity in their homes. In contrast, several respondents who experienced power failure and/or lost heat could not use generators because they did not own one.

It is unknown how respondents who lost power and did not own a generator survived the bitter cold experienced during the blizzards. Perhaps they lost power only for few hours and/or took shelter with neighbors or relatives. They may have borrowed a generator from their friends, neighbors, or relatives. Only five respondents indicated that friends, relatives, and/or neighbors took shelter in their home, and only two reported that several members of their families took shelter outside their homes after the blizzard started. No one reported the use of wood stoves or small kerosene-fueled heaters during the blizzard.

Table 2 presents information on the power status of respondents by the two types of sites considered in this study. For simplicity, as well as to avoid too many cells with numbers less than five, power status is classified into three categories: no loss of power, loss of power only for one day, and loss for more than one day. This table shows that about 69% of all respondents of non-isolated counties experienced no loss of power. The corresponding percentage was 63 for respondents of isolated counties. This finding is expected because the blizzard was more severe in isolated counties compared to non-isolated counties. However, the calculated chi-square value is not statistically significant (Table 2), indicating that the two types of study sites do not differ statistically with respect to power status.

It is surprising to report that not a single respondent received any emergency supplies, such as food, drinking water, warm clothing, and medicine, from any external sources. When respondents were asked whether they had enough food at their home during the December 28-31, 2006, blizzard, all of them answered affirmatively. This may be explained in two ways. First, residents of rural areas often buy and stock food for couple of weeks at a time because it is inconvenient and costly to frequently travel to buy food from nearby towns and cities. It might be equally possible that they bought enough food, especially food that does not need to be cooked, refrigerated, or frozen, after receiving the "blizzard warning." Survey data suggest that respondents also stored drinking water in their homes.

Although nearly 52% of all respondents experienced blizzard-induced damage of their properties, it is surprising that no respondent received any disaster relief from external sources immediately after the blizzard, nor did they receive any relief up until the time of the questionnaire survey was administered. Only two respondents—one from each study site—mentioned that they did not need any emergency aid for their families. As shown in Table 3, the proportion of respondents experiencing dam-

Table 2. Power status by study site

Number of Days Without Power	Non-Isolated Counties Number (%)	Isolated Counties Number (%)	Total Number (%)
0	22 (68.75)	19 (63.33)	41 (66.13)
1	7 (21.88)	4 (13.33)	11 (17.74)
>1	3 (9.37)	7 (23.33)	10 (16.13)
Total	32 (100.00)	30 (99.99)	62 (100.00)
<i>Chi-square=2.576 (d.f.=2; p=0.276)</i>			

age differs between the two study sites. Nearly 44% of all respondents of non-isolated counties incurred damage from the blizzard. This figure increases to 60% in isolated counties. However, again the calculated chi-square value is not statistically significant between the types of impacted counties (Table 3).

The survey data reveal that no respondent family experienced any blizzard-related fatalities, but two respondents reported that two family members fell on the ice and sustained broken knees and/or elbows. The December 28-31, 2006, blizzard, however, caused the collapse of multiple buildings in the selected study counties. The blizzard also damaged vehicles, fences, trees, windbreak trees, poles, and roofs. Respondent damage estimates range from \$200 to \$15,000. On average, each respondent experienced damaged valued less than \$1,000 and, probably for this reason, none of the respondents received any disaster relief from external sources.

Emergency Response Measures Undertaken for Stranded Cattle

As many as 60 of the 62 respondents provided information on the number of cattle they owned at the time of the December 28-31 blizzard. These include both cows and beef cattle. Three types of cattle operations are evident in the selected counties: beef cattle, cow calf, and dairy farms. Beef cattle are raised to fatten the animal, while cow calf operations involve breeding the cattle every year. Once calves are 500-750 lbs, producers sell them off. However, no

question was asked regarding what type of operation respondents were involved in. In addition to owning cattle, two respondents reported that part of their cattle herd was leased from other ranchers/farmers. The 60 respondents reported owning a total of 35,495 head of cattle. This means each respondent, on average, owned nearly 592 head of cattle at the time of the blizzard. However, the actual number of cattle owned by respondents ranged from 8 to 5,000.

Information presented in Table 4 clearly suggests that the two study sites differ with respect to cattle ownership. Respondents of non-isolated counties reported to have, on average, 919 head of cattle, opposed to only 264 head owned by respondents of isolated counties. This difference might be explained in terms of differences between soil quality and water availability of the two types of study sites. Because of the presence of an economically viable aquifer, cultivation of corn and other crops is a more prevalent agricultural enterprise among residents of isolated counties of Kansas compared to residents of non-isolated counties. However, the transportation network is better in non-isolated counties, which probably makes ranching more profitable (all other factors being equal) than in more isolated counties.

Respondents were asked about where their cattle were located during the blizzard. They mentioned several different areas, such as winter pasture, corn pasture, wheat pasture, field pasture, grass pasture, crop residue pasture, corn stalks, river bottom, home, corrals, and pens. These places are

Table 3. Respondents' damage experience by study site

Damage Experience Status	Non-Isolated Counties Number (%)	Isolated Counties Number (%)	Total Number (%)
Yes	14 (43.75)	18 (60.00)	32 (51.61)
No	18 (56.25)	12 (40.00)	30 (48.39)
Total	32 (100.00)	30 (99.99)	62 (100.00)
<i>Chi-square=1.637 (d.f.=1; p=0.201)</i>			

Table 4. Respondents' ownership of cattle by study site

Number of Cattle Owned	Non-Isolated Counties Number (%)	Isolated Counties Number (%)	Total Number (%)
<100	7 (23.33)	15 (50.00)	22 (36.67)
100-500	14 (46.66)	13 (43.33)	27 (45.00)
>500	9 (30.00)	2 (6.67)	11 (18.33)
Total	30 (99.99)	30 (100.00)	60 (99.99)
Average	919	264	
Range	8-5,000	10-4,000	
<i>Chi-square=7.401 (d.f.=2; p=0.025)</i>			

categorized as pasture and corral. The former are located away from the homestead and the latter are generally close to home. Cattle that were in pasture areas faced more hardship from the blizzard than those kept in pens or corrals. Because of the blizzard, it was difficult for respondents to travel to their pastures and feed cattle. Eight respondents—all from non-isolated counties—reported that after receiving blizzard warnings, they moved most of their animals from pasture areas to closer to their houses, home pens, or corrals. Three respondents mentioned that their cattle were in pastures located outside their own counties during the blizzard.

The questionnaire survey indicates that a small number of respondents kept their cattle in both pastures and corrals. The number of respondents keeping cattle in both pastures and corrals is split equally; no difference was found between respondents of isolated and non-isolated counties. Exactly half of the respondents in both types of sites left their cattle in pastures and corrals during the blizzard. When asked how many cattle they lost because of the blizzard, all 62 respondents provided an answer. Forty respondents (64.52%) reported that they lost cattle. The number of cattle deaths from blizzard impacts ranged from one to 120, but the percentage of respondents reporting cattle losses does not differ between the two study sites.

In all, 475 cattle owned or attended by respondents died in the study area because of the blizzard (Table 5). This means, on average, each one of the 40 respondents lost about 12 cattle. This can also be expressed in another way: the blizzard caused slightly over 13 deaths per 1,000 head of cattle. This death toll among cattle can be considered relatively

high. Two explanations can be provided for the high death toll of cattle in the selected counties of Colorado and Kansas. First, the overall high death toll reflects the severity of the blizzard. Second, the number of deaths included those that occurred after the blizzard in the form of still births and the deaths of both older cattle and underweight and premature calves born to cows stressed by successive blizzards and extremely cold temperatures. A rancher in Kit Carson County, Colorado, estimated a 15-20% calf loss due to the late December blizzard.

Information presented in Table 5 suggests that the number of cattle deaths differs between the respondents of isolated and non-isolated counties. Only 23% of all reported cattle were owned by the respondents of isolated counties, but they accounted for 59% of all cattle deaths. Respondents of isolated counties also experienced a higher death rate per 1,000 cattle (Table 5). A similar situation is also evident in the case of the average number of cattle lost by respondents of the study area (Table 5). This finding strongly supports the contention that the blizzard of December 28-31 was more severe in isolated counties as compared to non-isolated counties.

Apart from cattle deaths attributed to the blizzard, major (indirect) losses include higher feed intake to maintain body weight of cattle, a 10-15% weight loss of animals, lower rate of gain of feeder cattle, lighter weaning weights, and more death losses at calving time. Moreover, ranchers and farmers of blizzard-affected areas had to buy hay at higher prices because of a lack of winter grazing both in terms of stocks and native grass. Feed was expensive due to years of drought. Given the lower rates of weight gain due to the cold, one Kansas rancher

Table 5. Number of cattle deaths by study site

Number of Cattle Deaths	Non-Isolated Counties Number (%)	Isolated Counties Number (%)	Total Number (%)
1-5	9 (47.37)	14 (66.67)	23 (57.50)
6-20*	8 (42.11)	4 (19.05)	12 (30.00)
>20	2 (10.52)	3 (14.63)	5 (12.50)
Total	19 (100.00)	21 (100.00)	40 (100.00)
Total Cattle Death	194	281	475
Average	10.21	13.38	11.88
Range	8-58	1-120	1-120
Death per 1,000 cattle	7.04	35.46	13.38
<i>Chi-square=1.520 (d.f.=1; p=0.218)</i>			

* Merged with next higher category to calculate Chi-square value.

estimated that it took \$0.05-0.10 extra in feed to add one pound of weight to cattle. Thus, it cost an extra \$70 to fatten each animal up by 700 pounds. When multiplying the \$70 by the number of head held, the increased production costs are not insignificant. A considerable number of producers had feed bales in the field, but could not get to them to cattle because of the snow depth and/or drifts.

Lost production from stressed cattle and higher prices of feed have already reduced profits for producers. Ranchers have lost thousands of dollars in weight gains due to the blizzard and persistent cold weather. The hay feeding primarily kept the animals alive, rather than increasing weights. Veterinarians fear that the effect of weight loss of cows could stretch into this summer's breeding season, delaying the time when cattle would ordinarily breed. One respondent at Eads said, "Suspecting a delayed reproduction cycle, lots of ranchers in the blizzard-affected areas will sell their cows. This means they have to buy or raise more replacements."

Likewise, one rancher in Sherman County, Kansas, noted that while the weather was still cold and the ground was snow covered during January and the early part of February, nobody wanted extra cattle to feed. Thus, they were sold. The upside of the blizzard is that moisture, which has been "unknown" in the last five years in this part of western Kansas, will result in good pasture, and there was greater demand for calves this year. Similarly, in parts of southeast Colorado that had suffered high cattle losses, the blizzard-produced moisture will lead to greater grass production (important, as there is no irrigation and thus a dependency on grass year round) and to the desire to add to one's herd. The diminished calf crop, the reduction in herd size given the cost of providing feed for animals normally on pasture, and the outlook for increased grass production due to the blizzard-related precipitation means that ranchers will face higher prices for calves. At the livestock auction in Oakley, Kansas, on February 17, 2007, some calves were going for \$400 each, a price far higher than recent averages.

The blizzard may have affected cattle reproduction for years to come. In eastern Colorado, one county agricultural extension reported that bulls are experiencing reproductive problems due to frozen testicles. Cows whose embryos die early in the pregnancy due to the cold conditions face an added danger. If the embryo dies and it goes undetected, the mother cow is likely to be infected as a result of absorbing the embryonic tissue. This eventually

leads to death. The large number of stillborn or aborted calves leads to a lower number of replacement females. Such reproductive problems resulting from the blizzard may have an economic impact for the next three to five years.

Surprisingly, only one respondent from the isolated counties reported that during this blizzard his cattle received hay dropped by a Colorado National Guard helicopter. Eight Guard helicopters and a C-130 cargo plane were utilized in Colorado's campaign to save livestock herds trapped by heavy snow and high drifts. The state of Colorado picked up the tab for helicopter flights to deliver feed, but the cost of feed was either provided by the cattle owners or local governments. In Colorado, helicopter flights were primarily restricted to areas suffering the greatest impact such as Baca and Bent counties. In addition, volunteer snowmobile search-and-rescue groups joined the effort on the ground. Volunteers also used four-wheel drive vehicles and Humvees to supply feed to stranded cattle.

Several reasons might explain why cattle of almost all the survey respondents did not receive feed dropped by the Colorado or Kansas National Guards. As noted earlier, at least half of all the respondents surveyed reported that during this blizzard, either the entire herd or a portion of their herd stayed in cattle pens and corrals, which are located close to their homes. Cattle on a few other ranches were in pasture areas located near their homes. Additionally, some blizzard victims owned dairy farms, particularly in Hamilton County, Kansas. These farms are generally located close to homes. Helicopters dropped feed only for cattle stranded in open fields.

Cattle producers in some affected counties, such as Kiowa County, Colorado, were initially concerned that they would probably not be able to reach their animals with hay because of road conditions. All roads were cleared much earlier than expected, which facilitated their ability to reach the livestock (Sorensen 2007). For this reason, the air dropping of feed for stranded cattle was not necessary.

Three respondents of non-isolated blizzard-affected counties claimed that there was plenty of hay in their fields. Conversations with respondents, local officials, and residents revealed that emergency hay lifts were not undertaken in all blizzard-affected counties of Colorado and Kansas. For example, no one reported an air drop of cattle feed in Sherman and Thomas Counties of Kansas, nor in Kit Carson and Lincoln Counties of Colorado. As noted pre-

viously, cattle of several producers were in counties other than their own during the blizzard. The blizzard status of those counties was not known. All these facts suggest that air dropping of cattle feed was not widespread and was done selectively. Beyond supplying hay and snow removal in order to clear roads to reach cattle, there were no other emergency activities aimed at stranded cattle during this blizzard.

The questionnaire survey results reveal that only 8 (13%) of the 62 respondents received disaster relief from external sources for their cattle immediately after the December blizzard. All such respondents were from isolated counties, and they received cattle feed from several sources. Both individuals, such as Jim May, and corporations, such as Coors Inc., donated hay bales and pellet supplements in the severely impacted counties of Colorado. Two respondents reported that they picked up Coors-donated supplements from 60 miles away and it cost them \$0.63/bag. Each bag weighed 50 pounds and each respondent received up to 19 bags. The state of Kansas and Greeley County, Kansas, also distributed hay to respondents affected by this blizzard.

Respondents who received donated cattle feed complained that the hay distribution program was poorly executed and the pellets arrived late. One respondent claimed he received cattle feed three months after the blizzard. As a consequence, none of the eight respondents who received cattle feed were satisfied with the emergency aid provided by external sources for their cattle immediately after the blizzard.

It is clear from conversations with nearly two dozen affected people in the selected counties of Colorado and Kansas that concerned farmers and ranchers were very dissatisfied over not receiving any (or very little) emergency assistance from public sources for their stranded cattle and losses they incurred due to the blizzard. After the federal disaster declaration and approval of federal emergency funding distribution by the president, victims of the blizzard-affected counties expected federal disaster relief and emergency aid, including money for livestock rescue and recovery, from sources such as the Federal Emergency Management Agency (FEMA), the Small Business Administration (SBA), and the U.S. Department of Agriculture (USDA). However, most respondents were very disappointed because, to date, farmers, ranchers, and rural residents of the affected counties have received nothing from any of the mentioned organizations. Respondents indicated they are hoping for such aid in the near future.

Assistance provided by private sources was also inadequate. In contrast to federal and state emergency assistance, the Cattlemen's Associations of the blizzard-impacted counties have been helping fellow ranchers and others recover from the year-end blizzard. For example, considering the limited external aid, the Bent-Prowers Cattleman's board has been working since early January with the Colorado Cattleman's Association, the Colorado Farm Bureau, and the Colorado Livestock Association to coordinate unified efforts to bring relief to the local area (Russell 2007). The Bent-Prowers Cattlemen's board already provided cattle feed in the lower Arkansas Valley for those livestock owners in need due to impacts from the holiday winter storm. In addition, Little Caesar's Pizza and Land O'Lakes/Purina Mills Inc., as well as other business enterprises, made cash donations to aid ranchers affected by the blizzard.

Conclusion

The purpose of this research project was to explore and analyze emergency response and relief efforts undertaken for the December 28-31, 2006, blizzard victims in selected counties of Colorado and Kansas. Besides limited hay lifts and the supplying of hay and pellets for pick-up, the emergency response to the blizzard was limited. In Colorado, where Coors donated barley pellet supplement for feed, some ranchers felt the distribution could have been timelier in execution. Ranchers and farmers have not received federal disaster relief and emergency aid, such as money for livestock rescue and recovery. The federal government had made available emergency loans through the USDA, but no respondent reported to receive such loans at the time of the questionnaire survey.

To a large extent, in rural communities such as Kanorado, Kansas, farmers with tractors provided the disaster relief in dealing with the heavy snowfall and drifts by clearing the roads in town. One rancher interviewed in Kiowa County, Colorado, hoped one outcome of this study would be to raise awareness that there is a need for disaster relief to help cover farmers' and ranchers' added costs of procuring cattle feed and supplemental nutrition, and for economic disaster assistance in the form of a supplemental direct payment.

Farmers and ranchers (particularly in eastern Colorado) suffered major financial losses prior to the blizzard during seven years of severe drought, for which they also had not received any assistance. From their standpoint, the federal government re-

sponse to the blizzard has been disappointing. They saw very little federal relief forthcoming, and only a very slim possibility for state assistance. Although ranchers are not “holding their breath” for state or federal relief, such relief is greatly desired and to some degree expected, given the disaster declarations programs currently being implemented by FEMA and the USDA.

One factor leading to the limited assistance was that livestock do not fall under USDA crop disaster designations, since livestock are not a crop. One lo-

cal Cattlemen’s Association tried to get this changed so that livestock would fall under the same designation as a crop. If greater assistance is desired for future blizzards and droughts, state cattlemen’s associations must work on getting the USDA to change its crop disaster designations. The findings of this research should help local and state disaster managers to successfully plan recovery and rescue operations for victims of future blizzards in the study area and elsewhere.

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Notes

¹ In parts of the affected states, the storm began with freezing rain and drizzle, which then turned to snow.

² According to the National Weather Service (NWS 1999), a blizzard is defined as having falling or blowing snow with winds in excess of 35 miles (53 km) per hour and visibility of less than 0.25 mile (0.4 km) for a minimum of three hours.

³ Hypothermia is a condition brought on when the body temperature drops dangerously low.

⁴ It is worth noting that the counties ultimately selected from Colorado were different from ones initially proposed. For non-isolated Colorado counties, Elbert and Arapahoe Counties were originally selected. These two counties are located in close proximity to Denver and thus it was suspected that ranching might not be an important farming enterprise in these urbanized counties. As an alternative, Lincoln and Kit Carson Counties, located along I-70, were selected. After consulting with Bruce Fickenscher of the Colorado State University Cooperative Extension Office located at Eads, Colorado, Kiowa and Baca Counties were selected. Kiowa was not initially selected; it replaced Prowers County. Unfortunately, no one from Baca County responded to the mailed questionnaire.

⁵ It was expected that response rate would increase if the respective county agricultural extension officials mailed the questionnaire directly to blizzard victims.

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