New Mexico Sectors Vulnerable to Drought Draft

Jee Hwang (10/07)

Water use

Similar to Nebraska and Colorado, Agriculture is the largest freshwater user in New Mexico. About 88% of the total freshwater available is used to irrigate 33% (844,799 acres) of the total farmland (2002 census). The rest is used for public supply (9%), thermoelectricity (2%), domestic (1%), and industrial (< 1%). Surface water makes up 53% of the total freshwater source and 47% from Ground water where again most of which is used for irrigation. The top 3 ground water use counties are Chaves, Curry, and Lea. The top 3 surface water use counties are Dona Ana, San Juan, and Valencia. Overall, Dona Ana, Chaves, and San Juan counties use the most water.

Agriculture

New Mexico agriculture cash receipts amounted to $2.6 billion in 2005 (NASS 2005). Livestock products (Meat animals, Milk, Poultry, and Wool) accounted for $2 billion while Crops (Food grains, Feed crops, cotton, peanuts, vegetables, fruit and nuts) accounted for the remaining $600 million. New Mexico's farm real estate value has consistently increased since 2002. The average per acre value of $250 per acre in 2002 has jumped to $360 in 2005 and again to $520 per acre in 2006. See Figure 1.

Crops

Majority of the principle field crops are concentrated in the eastern region of New Mexico. Curry, Roosevelt, Union, Quay, Lea, and Chaves counties are New Mexico's top 10 producers of Corn (grain, silage), Cotton, Hay (All, Alfalfa), Wheat, Sorghum, and peanuts. Net income from farming was estimated at $621 million in 2005. Some of these counties such as Curry, and Roosevelt use ground water as their main source of irrigation and others such as Union and Chaves counties use surface water (Arkansas River Basin or the Pecos River Basin) to irrigate their crops.

Southern New Mexico leads the state in the production of Onions, Pecans, and Chile. Dona Ana is the top pecan producing county in the country accounting for 74% (48 million pounds) of New Mexico's pecan production and 17% of the country's total pecan production in 2005. Dona Ana also leads the state in Onion production and is ranked #2 in the state and #3 in the country for Chile. Luna County is the #1 Chile producing County in the country. An estimated $24 million in cash receipts in 2005 was from Luna County. Other notables are Hidalgo County which ranks #3 in the state and #4 in the country for Chile, and Otero County which ranks #4 in the state for Pecans. Main sources of irrigation for these counties are the Rio Grande River Basin, Lower Colorado River Basin, and the Pecos River Basin.

The rest of the state produces a mixture of miscellaneous Fruits and vegetables (Apples, Grapes, Peaches, Pears, and Tomatoes) and field crops (see Chart 1). San Juan leads in the production of wheat, hay, apples in this area and Bernalillo, Rio Arriba, and Valencia are the top Grape producers in the state. The main sources of irrigation for these counties are the Rio Grande River Basin, San Juan Basin and the Lower Colorado River Basin. See Figure 2.

Many counties rely on irrigation to hedge against times of low precipitation. The source of irrigation is not always dependent on local climate conditions. It is therefore important to observe climate conditions in the area of crop production as well as the area affecting the source of irrigation. For instance, precipitation in northern NM Mountains contributes to the stream flow of the Rio Grande River which stretches down to southern NM. The southern stretch includes the Elephant Butte Reservoir which is an important source of irrigation for pecan growers. To test this hypothesis, climate data for from the National Climatic Data Center, Elephant Butte content level data from the Natural Resource Conservation Service and finally pecan output data from the National Agricultural Statistics Service was obtained for the areas of interest in New Mexico. Upon running an OLS regression of northern NM precipitation (Division 2) on Elephant Butte content level, and a regression of Elephant Butte content level on Pecan output, coefficients are found to be positive and significant at the 1% level. Thus a statistical link has been made between northern NM precipitation, Elephant Butte content level, and pecan production in southern NM. Although are caveats associated with this analysis such as the existence of ground water irrigation as a source, but one could make the argument that much of the aquifers are recharged by stream flows. This analysis also found insignificant ties between pecan production in southern NM and southern NM precipitation (Division 8) and a weaker correlation between Elephant Butte content level and middle NM precipitation (Division 5) than that of with division 2, but further investigations may be needed to reach a more accurate conclusion. See Figure 3 and Appendix for results.

Another important fact to consider is climate impacts on perennial crops differ from annual crops. For instance, drought impacts for annual crops such as Chile peppers, corn, onions, vegetables, and peanuts are short lived since each year encompasses a new planting and harvest. In many instances, the farmer has the option to use crop rotation to maximize the use of land or leave the land unused. In this case, the farmer is most impacted by short term fluctuations in climate at critical development periods of the crop. However, drought impacts from previous years would not directly affect the outcome of the new plantings.

Drought impacts for perennial crops such as pecans and alfalfa are much more resilient and tend to linger into future harvest. These crops produce for multiple years, thus adequate moisture during developmental stages are critical. Pecan trees begin to produce at about year 6 until year 11. Young trees overstressed from lack of water tend to either die out while mature trees tend to under-produce for several seasons in lieu of sufficient irrigation water. This will force farmers to cut back on inputs either in the form of labor or trees. Alfalfa is an important feed crop used for forage and hay. It is harvested multiple times a year and can live from 3 to 12 years. Although the alfalfa is able to adapt to dry climates, severe dry conditions will inevitably decrease yields for farmers and raise input costs for the livestock industry.

Proper assessment of drought impacts on crops requires the distinction of annual types from perennial types and the availability of irrigation. This evaluation is essential for determining the time horizon of drought impacts so that proper contemporaneous economic losses can be identified.

Livestock

New Mexico's livestock industry is composed of meat animals (Cattle & Calves, Sheep & Lambs, Hogs and Pigs, Angora Goats), dairy, poultry & eggs, and miscellaneous others. Meat animals, particularly cattle & calves, and Dairy has been and remains the two dominate sources of cash receipts (see Chart 2). Prior to 2001, cattle & calves were top ranked in cash receipts (56% in 2000). However, drought conditions forced many ranchers to thin out herd numbers which included sheep due to insufficient rain for rangeland grasses. This continued through 2004 as ranchers continually either decreasing herd numbers or moving them into winter pastures. The ability to graze is particularly important for cattle and sheep thus rangeland conditions are vital to the well being of the state's meat industry.

The impact to the dairy industry was relatively insignificant. This may be due to the fact that rangeland conditions are not essential for milk production. The use of feed stocks is sufficient for milk cows and production, thus the state dairy industry has consistently grown in terms of number of heads, total milk production and milk production per cow making up nearly 50% of the total cash receipts and ranks top ten in the U.S. (NMAS 2005). Although direct impacts from drought appear negligible, indirect impacts such as an increase in the cost of electricity used to run generators that refrigerate stored milk could result in loss of milk inventory and/or declines in production. The situation presented above could precipitate from unusually hot and dry summers that increase the demand for cooling. The increase in demand would manifest itself in the form of higher electricity costs, thus increasing total input cost to the farmer.

Recreation and Tourism

According to the 2005 New Mexico Consumer Travel Data (Travel Industry Association, TravelScope 2005), fifty four percent of visitors to New Mexico are residents of the state. Many of the out-of-state visitors originated from Texas (15%), Arizona (8%), and California (6%). Main purposes of the visit include visiting family and friends (26%), business related (19%), general vacation (12%), convention/seminar (7%), and getaway vacation (5%). Popular trip activities include shopping (25%), touring/sightseeing (22%), visit historical sites (11%), and museums (6%). Within these groups of visitors, a majority are in the age range of 50-64 years old (38%) while the smallest percentage are of the 18-34 years old range (8%), and the average household income is $58,271.

See Charts 3-7.

Fishing, Hunting, and Boating

Recreational opportunities in New Mexico include over 3,000 miles of rivers and streams and 138,000 surface acres of cold and warm water lakes, plus hunting, and other outdoor activities (see Figure 4). Drought conditions that dry up lakes and streams affect revenues generated from fishing licenses. Lodging and restaurants that rely on visits by outdoor enthusiasts may be adversely affected if visitation rates sharply decrease. Drought conditions increase the risk of wild fires resulting in the loss of forest and game land. Contrary to expectations, Hesseln and Alexander (2001) found visits to the National Forest in New Mexico increased with fire intensity. The authors hypothesize that curiosity and the desire to see the aftermath of the fire may have been a factor.

Skiing

There are over 15 ski resorts in Northern New Mexico and a few in the southern region. Skier days are directly correlated with snow fall, so ski resorts will incur losses due to lack of snow fall brought on by drought. If local lodging and restaurants are dependent on skier visits, they will likely suffer losses from significant decreases in snow fall. See Figures 5-7.

Real Estate

Another sector that has not received much attention is the real estate sector. Past research shows that property values located in a flood zone tend to be lower, but identifying a "drought zone" is not as concrete if possible at all. However, it is clear that some disasters brought on by drought conditions cause property damage and loss in value of neighboring real estate. Taos experienced a 15 percent drop in home sales in 1997 due to forest fires and drought conditions in 1995-1996 (NM Business Journal: March, 1998). It is unknown at the moment exactly how drought conditions affect agricultural real estate values but the magnitude of the loss due to wild fires crop damage will likely be high.

Conclusion

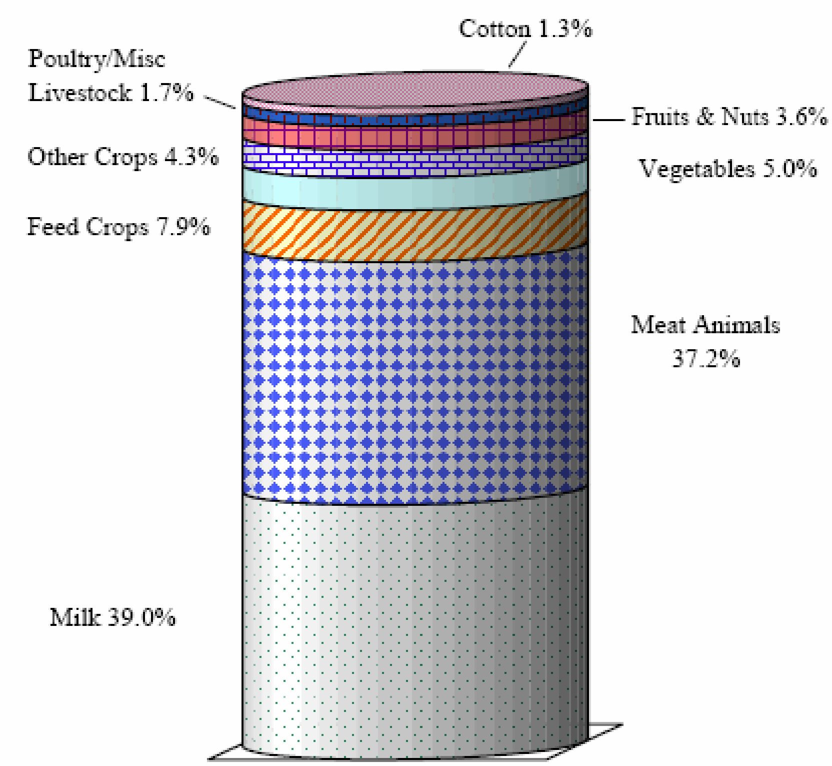
The agricultural sector relies heavily on irrigation to avoid crop losses due to drought conditions. However, in times of severe drought, irrigation abilities may be short lived due to water claims and high pumping costs. It is important to recognize that regional climate is just as important as local climate. The livestock industry is sensitive to drought impacts, particularly the meat industry. Pastureland/rangeland is vital to ranchers but may not be as important to the dairy farmer. Many visitors to New Mexico visit friends and family members and participate in activities such as shopping and visit historical sites. This type of visitation activities is unlikely to be significantly impacted by drought. It is more likely that precipitation will decrease visitation rates than increase it. Winter snowpack in the northern NM Mountains impact the ski industry as well as the agricultural industry dependent on spring stream flows. Dry conditions increase the potential for wildfires that threaten forest and game land as well as urban and agricultural property. However, visitation to National Forests shortly after a forest fire may increase due to human curiosity.

Works Cited

1. Hesseln, Hayley, and Susan J. Alexander. "Summary Report of the Effects of Fire on Recreation Demand in New Mexico." (2001).
2. Hesseln, Hayley, and Susan J. Alexander. "Summary Report of the Effects of Fire on Recreation Demand in New Mexico." (2001).
3. New Mexico Agricultural Statistics. United States Department of Agriculture. National Agricultural Statistics Service, 2005.
4. TravelScope New Mexico Trends. TravelScope. David Sheatsley & Partners.
5. Traver, Nancy. "The Housing Market Cools Off." New Mexico Business Journal Mar. 1998. 12 Sept. 2007 <http://findarticles.com/p/articles/mi_m5092/is_n3_v22/ai_20522957>.

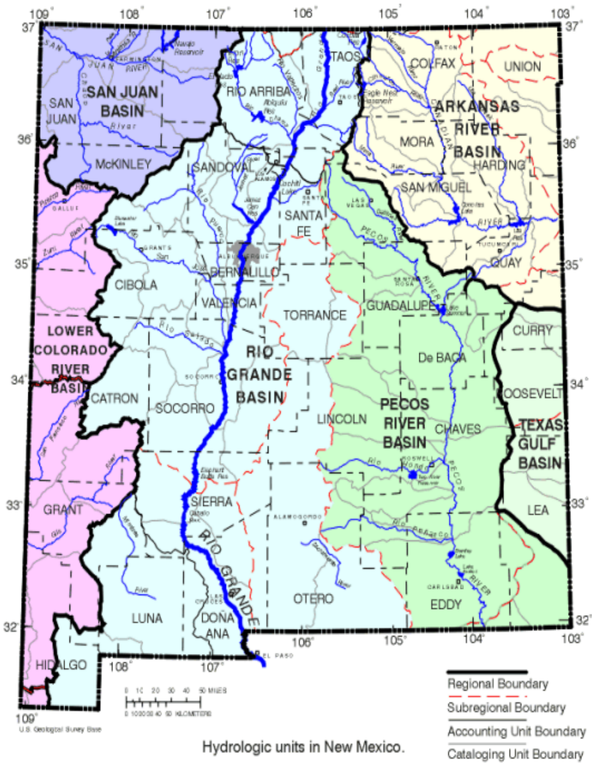
Figures

Figure 1. New Mexico Cash Receipts, 2005: All Commodities



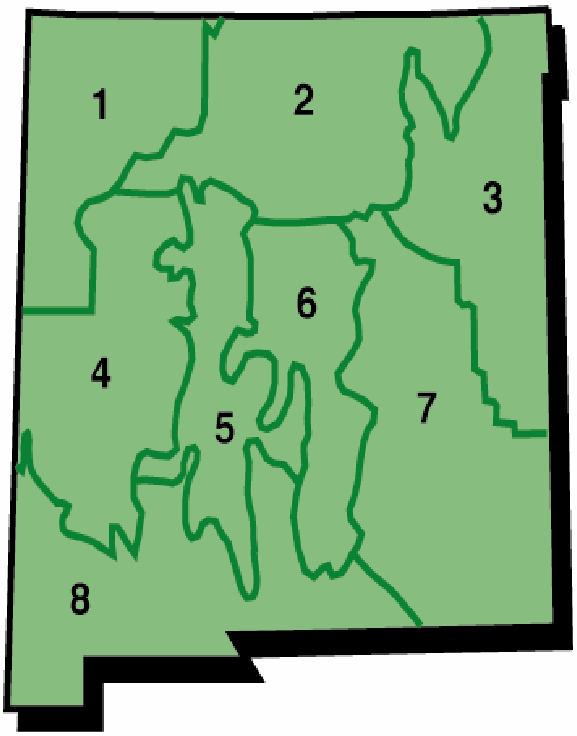
Source: National Agricultural Statistics Service, USDA

Figure 2. New Mexico Hydrologic Units



Source: U.S. Geological Survey

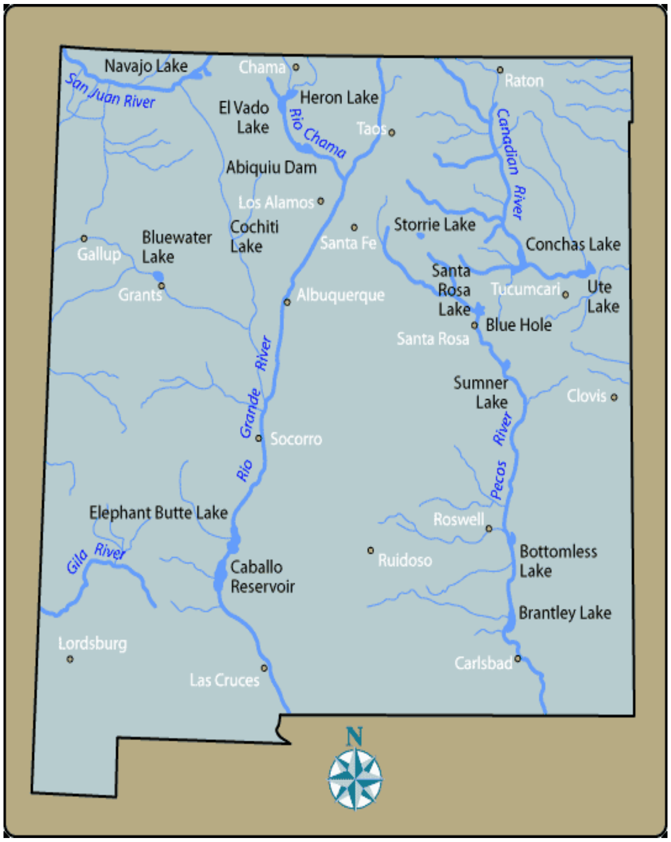
Figure 3. New Mexico Climate Divisions



Source: New Mexico Drought Task Force

1. Northern Plateau
2. Northern Mountains
3. Northern Plains
4. Southwest Mountains
5. Central Valley
6. Central Highlands
7. Southern Plains
8. Southern Desert

Figure 4. New Mexico Lakes and Reservoirs



Source: New Mexico Tourism Department

Figure 5-6. Winter Precipitation and Skier days for Taos and Red River Ski resorts

Figure 5

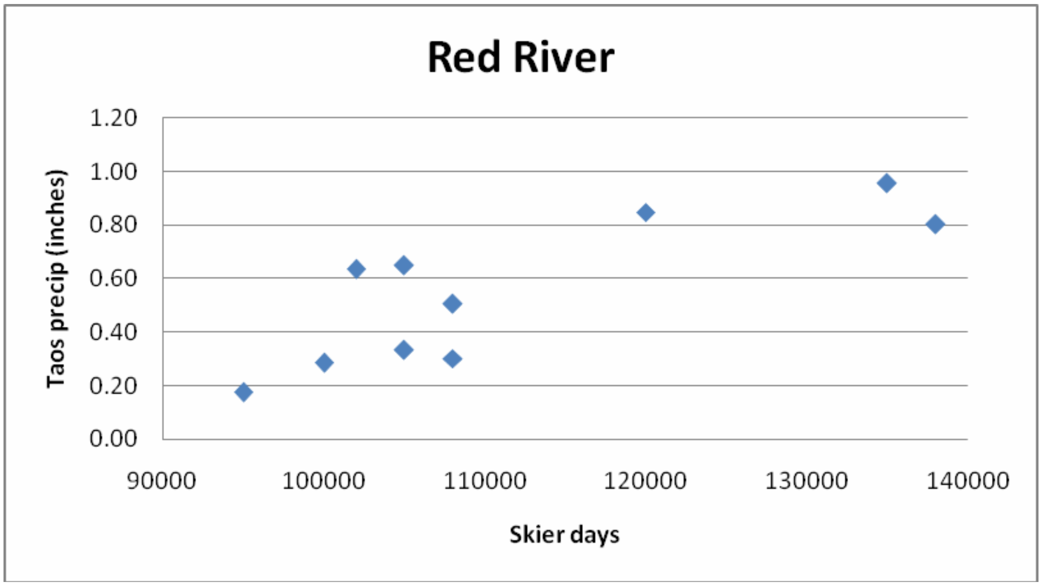
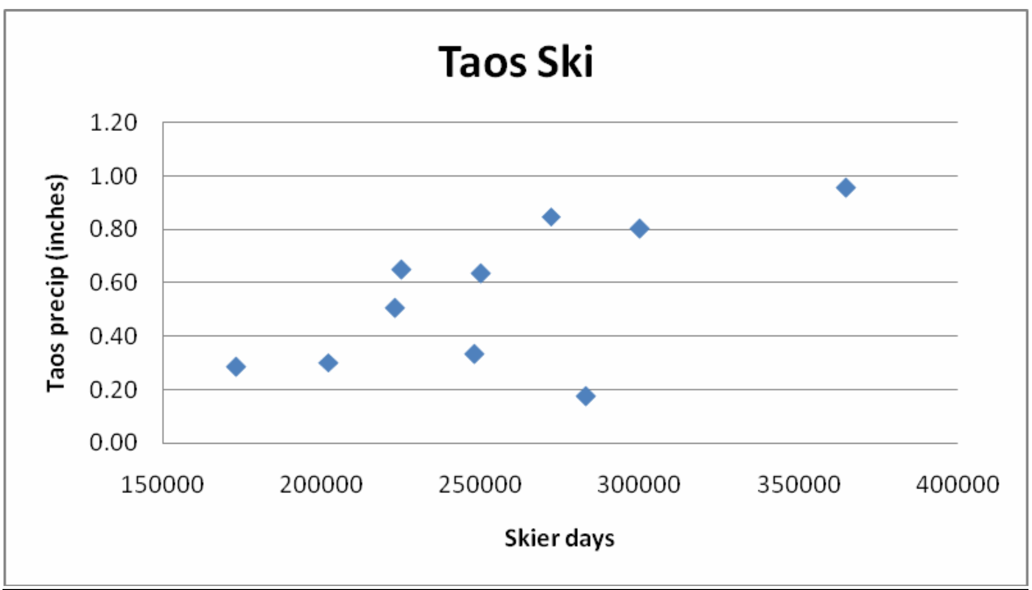
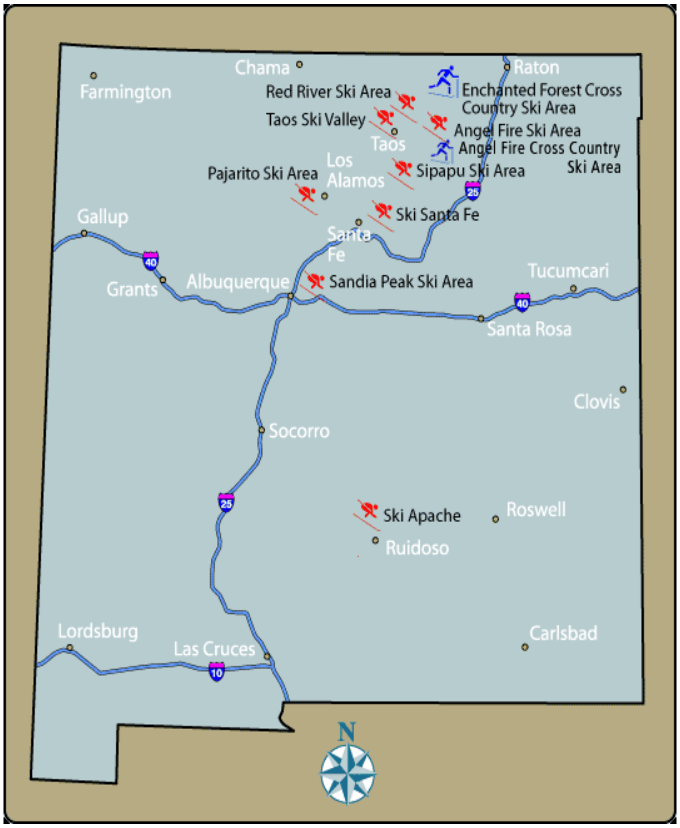


Figure 6



Source: Western Regional Climate Center, National Climate Data Center: U.S. Department of Commerce

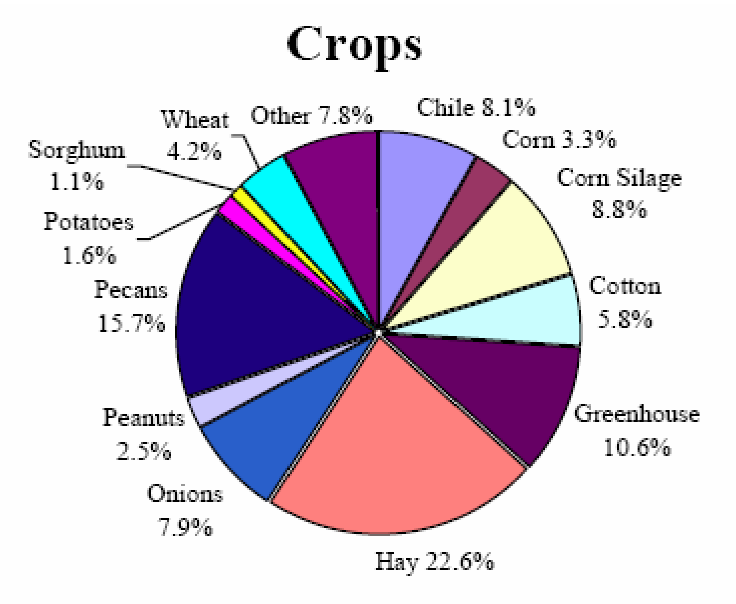
Figure 7. New Mexico Ski Resorts



Source: New Mexico Tourism Department

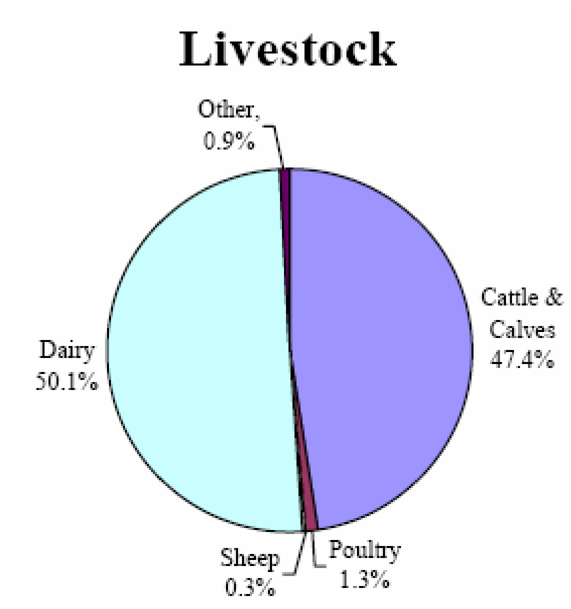
Charts

Chart 1. New Mexico Cash Receipts, 2005: Crops



Source: National Agricultural Statistics Service, USDA

Chart 2. New Mexico Cash Receipts, 2005: Livestock



Source: National Agricultural Statistics Service, USDA

Charts 3-7. Recreation and Tourism, 2005

Chart 3

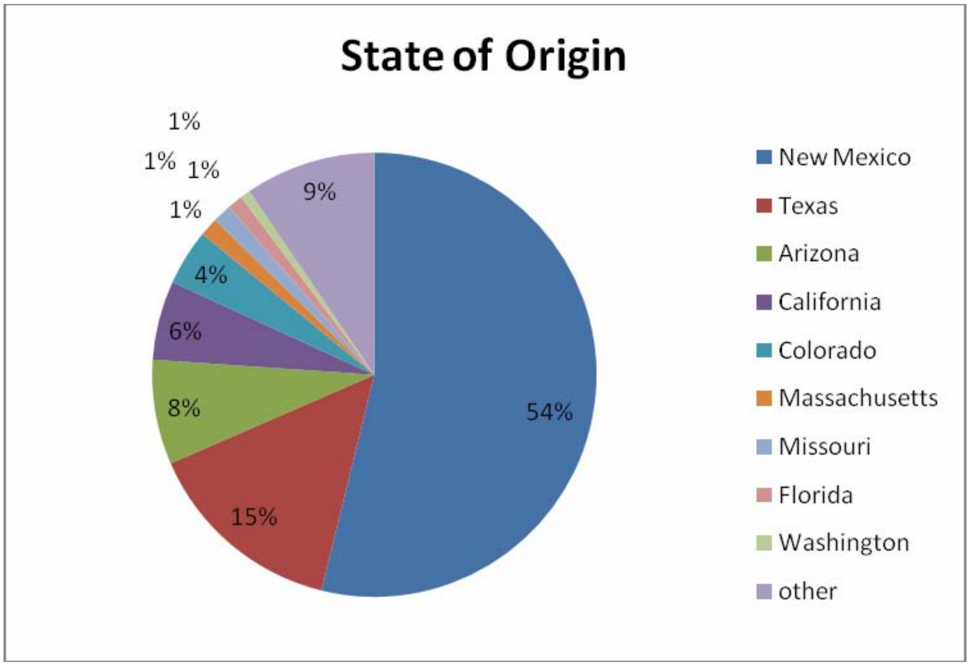


Chart 4

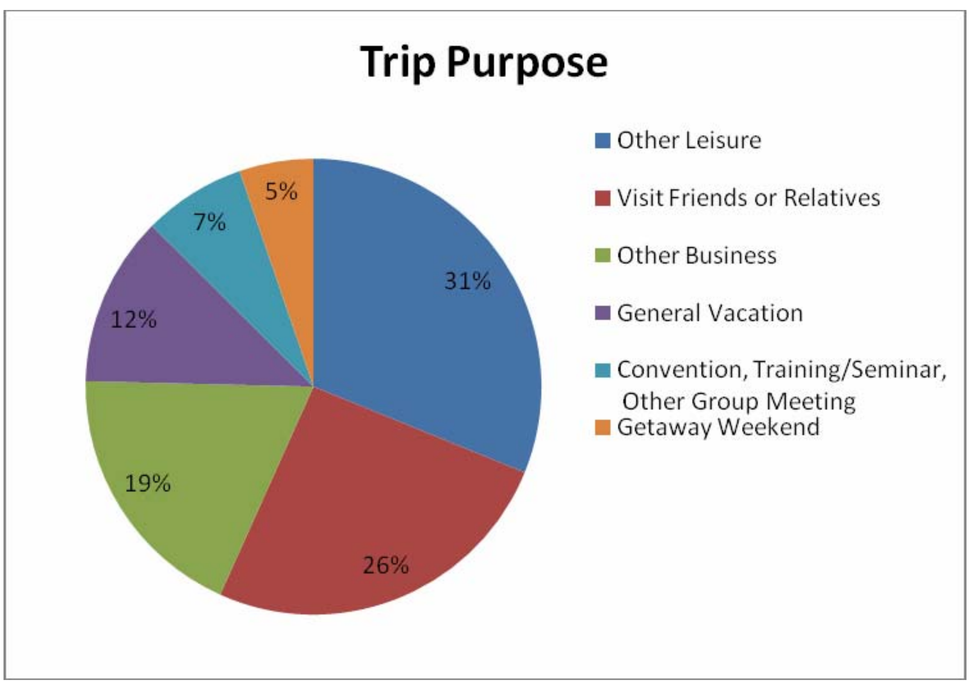


Chart 5

Chart 6

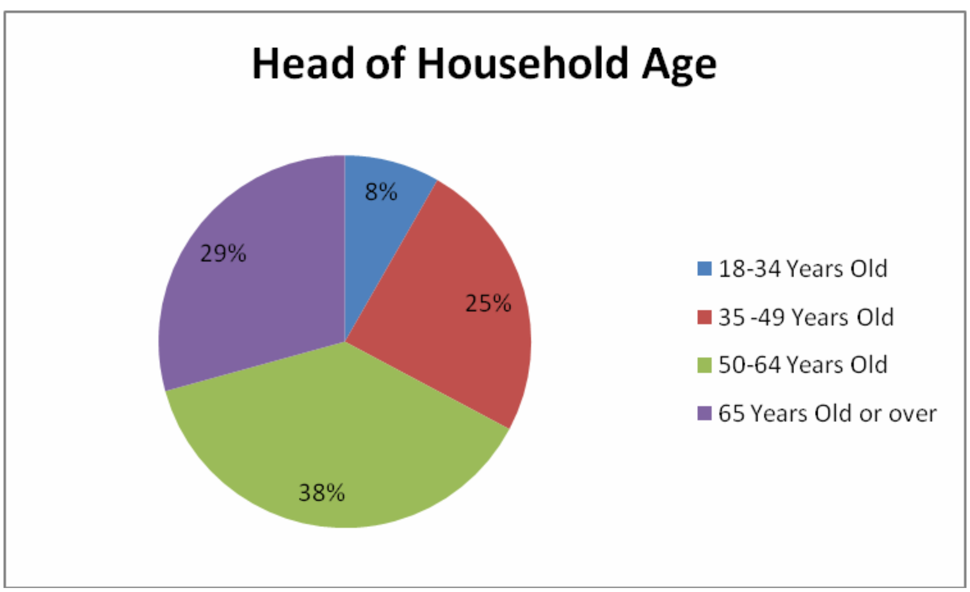
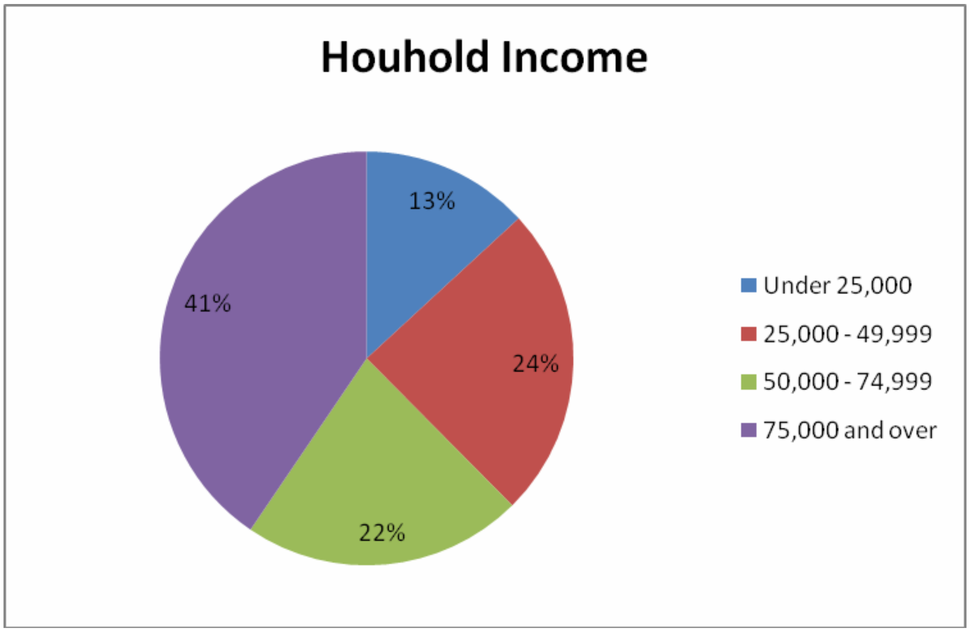


Chart 7


Houhold Income
13%
24%
22%
41%
Under 25,000
25,000 - 49,999
50,000 - 74,999
75,000 and over

Appendix

Data description - Annual series for the years 1964 to 2006

nmprod: New Mexico pecan production in thousands of pounds

usprod: U.S. pecan production in thousands of pounds

tempavgk: average temperature for the irrigation months (Jan, Mar to Oct) in climate division ‘k’

precavgk: average precipitation for the irrigation months in climate division ‘k’

pdsiavgk: average Palmer Drought Severity Index (-∞,∞) for the irrigation months in climate division ‘k’

zavgk: average Palmer ‘Z’ Index (-∞,∞) for the irrigation months in climate division ‘k’

eleph: annual content level for Elephant Butte Reservoir in thousands of acre-feet

nmacres: estimated total pecan acreage for New Mexico. Based on regression of 8 data points

nmprodac: estimated total New Mexico pecan production per acre

pricer: ratio of nmprod by usprod (nmprod/usprod)

L.y: lag of variable ‘y’

ln(y): natural log of variable ‘y’

Dependent Variable: nmprod

Model 1	**n = 43**		**Model 1.1 (lag-variables)**	**n = 42**	
Variable	***coefficient***	***t-ratio***	***Variable***	***coefficient***	***t-ratio***
constant	-470346***	-4.52	constant	-508375.9***	-5.09
tempavg8	7575.405***	4.72	L.tempavg8	8156.916***	5.33
precavg8	3272.608	0.44	L.precavg8	3986.626	0.51
eleph	0.0069467**	2.52	L.eleph	0.0075788***	2.87
R-sq	0.4568		R-sq	0.544	

Model 2	**n = 43**		**Model 2.1 (lag-variables)**		**n = 42**
Variable	***coefficient***	***t-ratio***	***Variable***	***coefficient***	***t-ratio***
constant	16519.89***	4.14	constant	14875.75***	3.88
zavg8	-1321.763	-0.58	L.zavg8	-3854.558*	-1.78
eleph	0.0093215**	2.67	L.eleph	0.120533***	3.61
R-sq	0.1533		R-sq	0.2534	

Model 3	**n = 43**		**Model 3.1 (lag-variables)**		**n = 42**
Variable	***coefficient***	***t-ratio***	***Variable***	***coefficient***	***t-ratio***
constant	15932.64***	3.93	constant	13988.51***	3.84
pdsiavg8	-831.2845	-0.89	L.pdsiavg8	-1841.752**	-2.12
eleph	0.0101843***	2.74	L.eleph	0.0133256***	3.84
R-sq	0.1626		R-sq	0.2389	

*, **, *** denote significance at the 10%, 5%, 1% level

Dependent Variable: ln(nmprod)

Model 1	**n = 42**		**Model 2**	**n = 42**	
Variable	***coefficient***	***t-ratio***	***Variable***	***coefficient***	***t-ratio***
constant	-10.83373***	-2.56	constant	-16.38951***	-4.00
L.tempavg8	0.3157482***	4.77	L.tempavg8	0.3175095***	4.98
L.eleph	5.39e-07***	4.85	L.ln(eleph)	0.443829***	5.32
R-sq	0.5780		R-sq	0.6078	

*, **, *** denote significance at the 10%, 5%, 1% level

<u>Dependent Variable: nmacre</u>

Model 1	**n = 8**	
Variable	***coefficient***	***t-ratio***
constant	-1401616***	-6.78
year	716.5245***	6.90
R-sq	0.8880	

*, **, *** denote significance at the 10%, 5%, 1% level

Estimated values for nmacres = -1401616+716.5245*year
Estimated nmprod per acre = nmprodac = nmprod/nmacres

<u>Dependent Variable: ln(nmprodac)</u>

Model 1	**n = 42**	
Variable	***coefficient***	***t-ratio***
constant	-8.918632***	2.73
L.tempavg8	0.1113938***	2.89
L.ln(eleph)	0.1379076***	2.73
R-sq	0.3157	

*, **, *** denote significance at the 10%, 5%, 1% level

<u>Dependent Variable: ln(eleph)</u>

Model 1	**n = 43**	
Variable	***coefficient***	***t-ratio***
constant	13.46917***	116.58
pdsiavg2	0.2117857***	4.29
R-sq	0.3097	

Model 2	**n = 43**	
Variable	***coefficient***	***t-ratio***
constant	13.36061***	97.17
pdsiavg5	0.1462132**	2.45
R-sq	0.1275	

Model 3	**n = 43**	
Variable	***coefficient***	***t-ratio***
constant	11.60581***	2.48
precavg2	1.204214**	15.24
R-sq	0.1309	

Model 4	**n = 43**	
Variable	***coefficient***	***t-ratio***
constant	12.36498***	20.44
precavg5	1.134875*	1.87
R-sq	0.0679	

Model 5	**n = 43**	
Variable	***coefficient***	***t-ratio***
constant	13.48026***	109.72
zavg2	0.4253953***	3.40
R-sq	0.2199	

Model 6	**n = 43**	
Variable	***coefficient***	***t-ratio***
constant	13.36451***	94.88
zavg5	0.3123912**	2.15
R-sq	0.1011	

*, **, *** denote significance at the 10%, 5%, 1% level

2-Stage Least-Squares regression

Dependent Variable: L.ln(eleph)

Model 1	**n =42**	
Variable	***coefficient***	***t-ratio***
constant	13.47675***	116.91
pdsiavg2	0.2097838***	4.29
R-sq	0.3046	

Dependent Variable: ln(nmprod)

Model 1.1	**n = 42**	
Variable	***coefficient***	***t-ratio***
constant	-15.7013***	-3.91
L.tempavg8	0.3126793***	5.04
L.ln(eleph)	0.4157287***	3.26

Dependent Variable: ln(nmprodac)

Model 1.2	**n = 42**	
Variable	***coefficient***	***t-ratio***
constant	-7.111376***	-3.91
L.tempavg8	0.987097***	2.63
L.ln(eleph)	0.0641159	0.82

Dependent Variable: pricer

Model 1.3	**n = 42**	
Variable	***coefficient***	***t-ratio***
constant	3.892855***	4.89
L.tempavg8	-0.0261642**	-2.05
L.ln(eleph)	-0.0796115***	-2.80

Dependent Variable: ln(pricer)

Model 1.4	**n = 42**	
Variable	***coefficient***	***t-ratio***
constant	2.461746***	3.52
L.tempavg8	-0.021967**	-1.97
L.ln(eleph)	-0.0685539***	-2.76

*, **, *** denote significance at the 10%, 5%, 1%
level

nmacres = -1401616 + 716.5245(year)