National and State Economic Values of Cattle Ranching and Farming-Based Ecosystem Services on Federal and Private Lands in the U.S.

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University of Wyoming, College of Agriculture and Natural Resources, August 2020

INTRODUCTION

The 2017 Census of Agriculture classified nearly 641,500 agricultural operations in the U.S. as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 362.5 million acres of private land, including 274.3 million acres of pasture/rangeland. They also utilized an estimated 125.9 million acres of Bureau of Land Management (BLM) land and 59.2 million acres of U.S. Forest Service (USFS) land (Reeves, 2020). Combined, this land base represented more than one-third of non-metro, non-urban land in the nation and supported more than 23.5 million head of beef cows in 2017. The production from these ranches generated $34.7 billion of gross revenue, including $29.4 billion from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in the U.S. was estimated to be $655.4 billion. U.S. beef cattle ranches also employed more than 2.1 million workers including producers, hired labor, and family labor in 2017.

The economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Additional economic values associated with beef cattle ranching and farming include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space (Maczko and Hidinger, 2008). These ecosystem services from beef cattle ranching may not be available from alternative land uses, and may be affected by private and federal land management and policy decisions; loss of these services also may be irreplaceable or difficult to replace with human-made services (Avise 2002, Salles 2011).

The work presented here is intended to document the value of select ecosystem services associated with the conservation of land use for beef cattle production. Quantitative information for use in public policy and planning, such as assessments of potential land use change, is also provided. Note that all figures are conservative, representing just three of the myriad of ecosystem services provided in association with beef production. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits (MEA, 2005). Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data including the 2012 Census of Agriculture (USDA, 2014).

This report updates and expands estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production in the U.S. Data from the 2017 Census of Agriculture and estimates of the ecosystem service value of cattle grazing on federal lands were both utilized in this analysis. Box 1 summarizes the methods and data sources used to derive estimates of ecosystem services value per acre. Forage production values for private pastures/rangelands associated with beef cattle ranching were approximated from the National Agricultural Statistics Service (NASS) U.S. and state average per acre pasture rental rate data (NASS, 2017). Forage production values for federal rangelands associated with beef cattle ranching were calculated on a per acre basis from monthly per animal unit (AUM) grazing fee rates for cattle (NASS, 2019). Specific information on the quantity of grazing on federal lands (in AUMs) for the 16 U.S. states governed by the federal grazing fee was obtained from 2018 Public Land Statistics (BLM, 2019) and the FY 2016 Grazing Statistical Summary (USFS, 2017). General ecosystem services values were estimated using the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on U.S. Fish and Wildlife Service (USFWS) estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic val-

Box 1.

DATA SOURCES FOR PER ACRE ECOSYSTEM VALUE ESTIMATES

Federal Forage: Estimated using monthly per animal unit grazing fees for cattle (NASS, 2019) multiplied by the number of AUMs purchased (BLM, 2019, USFS, 2017) and divided by the total number of acres in federal allotments (Reeves, 2020).

Private Forage: Taken from U.S. and state average per acre pasture rental rates (NASS, 2017).

General Services: Approximated by Conservation Reserve Program (CRP) – Grasslands annual rental payment per acre to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). In contrast to other voluntary CRP programs that may not allow grazing, participant landowners and operators retain the ability to graze while receiving support to maintain plant and animal biodiversity. This program emphasizes areas threatened by conversion to other land uses. Participants receive annual payments and optional cost-share assistance. Contract duration is between 14 and 15 years.

Wildlife Values: Derived from estimates of state wildlife recreation days for hunting, fishing (excluding salt water and Great Lakes fishing) and wildlife watching (USFWS, 2014) multiplied by estimates of net economic values for wildlife-related recreation (USFWS, 2016). This total was then converted to a per acre figure based on the number of non-metro, non-urban acres in the state (EPS, 2019).

ues for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem services values of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019).

The combined per acre value estimates from above were translated into ecosystem services estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production.[1] The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. The total acres of federal rangeland were obtained through a GIS analysis of federal grazing allotments (Reeves, 2020). These total ecosystem services values derived from beef cattle ranching pasture/rangeland acres were divided by the number of beef cows produced by the industry (Table 2) to get a value per beef cow.[2] The value per beef cow was divided by the pounds of retail beef per beef cow according to Livestock Marketing Information Center (LMIC) to get a value per pound of retail beef.

Table 1 and 2 show the national data from the 2017 Census of Agriculture as an example of the specific information taken from the Census of Agriculture for this analysis. The beef cattle ranching and farm industry (NAICS 112111) data provide the most accurate and conservative estimate of pasture/rangeland acres used primarily for beef production.[3] This industry also produced the largest percentage of beef cows and utilized more private pasture/rangeland acres in the U.S. than the other agricultural industries combined (Table 2). Data from the 2012 Census of Agriculture were also included in the analysis to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. All dollar amounts were expressed in 2017 dollars.

This analysis provides conservative estimates of the value of ecosystem services from beef production in the U.S. in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111) (Table 2).

1 The total value of ecosystem services is calculated in general as the per acre value times the number of pasture/rangeland acres utilized by beef cattle ranches and farms; Total Cattle Ranching Based Ecosystem Services=Per Acre Value Federal*Number of Federal Acres+Per Acre Value Private*Number of Privately Owned Acres

2 Beef cows are considered the production unit of interest in beef cattle ranching and farming. Table 1 provides a breakdown of the cattle inventory data provided by the 2017 Census of Agriculture.

3 Other industry classifications produce beef cattle, but also have a majority of their operation in a variety of other types of livestock or production activities. Including pasture/rangeland acres from these other industries would provide an overestimate of ecosystem services value. For example, nationally there were 11.4 million acres of pasture/rangeland reported in the 2017 Census of Agriculture under the sheep and goat farming industry classification. While this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

Table 1. The break-down of the national Cattle and Calf Inventory as reported in the 2017 U.S. Census of Agriculture. Beef cows are the unit of production of interest in this economic valuation.

2017 Ag Census Categories	National Cattle Numbers
Beef cows** (a)	31,722,039
Milk cows (b)	9,539,631
Cows and Heifers that have Calved (a+b)	41,261,670
Other Cattle* (c)	52,386,371
Cattle and Calves inventory (a+b+c)	93,648,041

*Data includes heifers that had not calved, steers, calves, and bulls.
**More information about the number of beef cows and pasture/rangeland acres considered in this analysis can be found in Table 2.

Table 2. The break-down of the number of beef cows and private pasture/rangeland acres in the nation according to NAICS Classification as reported in the 2017 U.S. Census of Agriculture. The data highlighted in gray were used for this analysis.

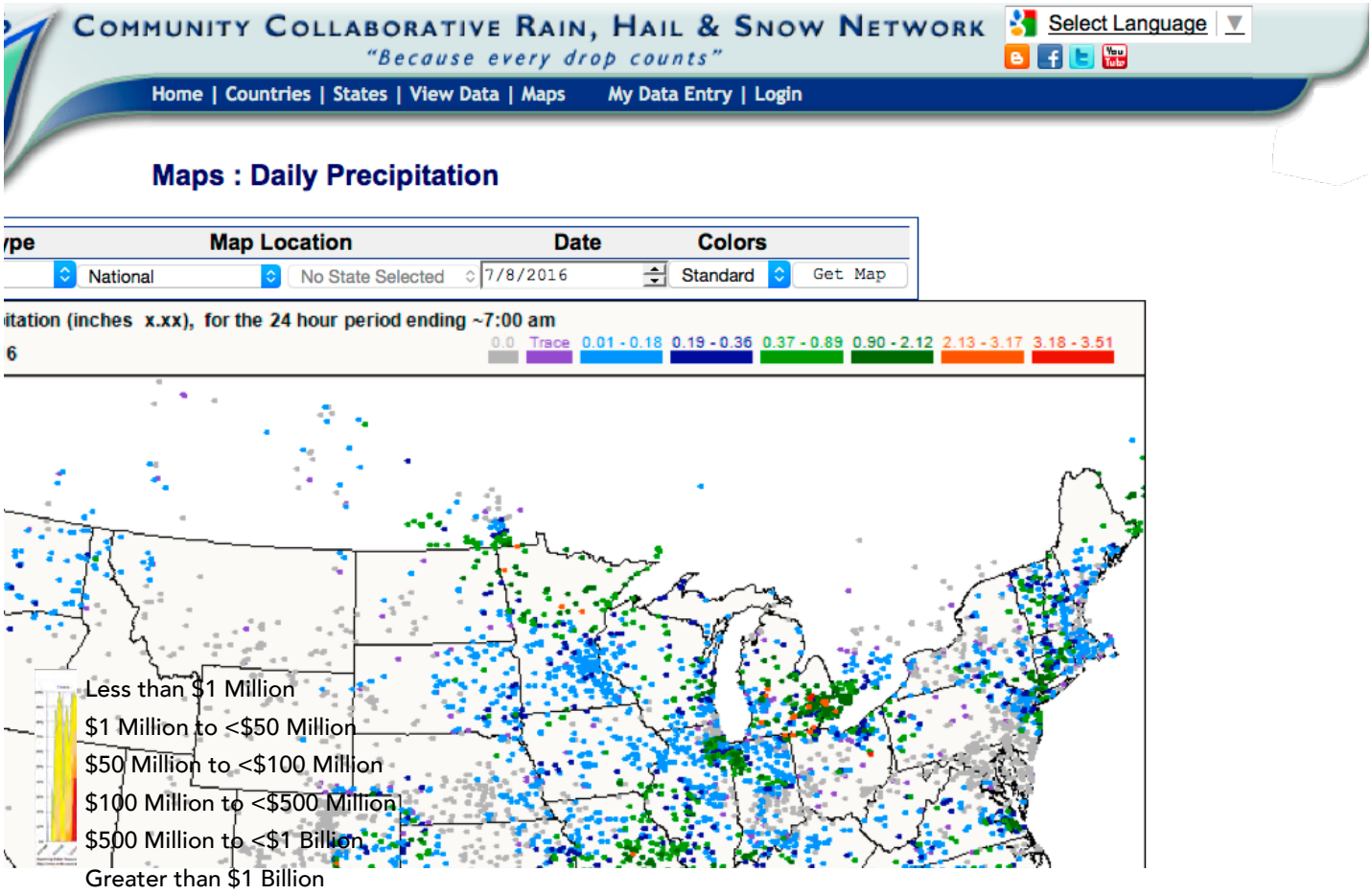
NAICS Classification Title (Number)	Beef Cows	Percent of Total Beef Cows	Private Pasture/ Range Acres	Percent of Total Private Pasture/ Rangeland Acres
Oilseed and Grain Farming (1111)	3,977,056	12.5%	26,716,888	6.7%
Vegetable and Melon Farming (1112)	84,503	0.3%	890,374	0.2%
Fruit and Tree Nut Farming (1113)	156,827	0.5%	2,808,531	0.7%
Greenhouse, Nursery, and Floriculture Production (1114)	37,952	0.1%	412,609	0.1%
Other Crop Farming* (1119)	1,833,774	5.8%	27,418,134	6.8%
Beef Cattle Ranches and Farms (112111)	23,502,870	74.1%	274,320,871**	68.4%
Beef Cattle Feedlots (112112)	845,208	2.7%	7,834,041	2.0%
Dairy Cattle and Milk Production (11212)	227,035	0.7%	2,106,089	0.5%
Hog and Pig Farming (1122)	126,319	0.4%	436,952	0.1%
Poultry and Egg Production (1123)	541,270	1.7%	1,576,897	0.4%
Sheep and Goat Farming (1124)	98,004	0.3%	11,377,202	2.8%
Aquaculture and Other Animal Production (1125 & 1129)	291,221	0.9%	44,872,590	11.2%
Total	31,722,039		400,771,178	

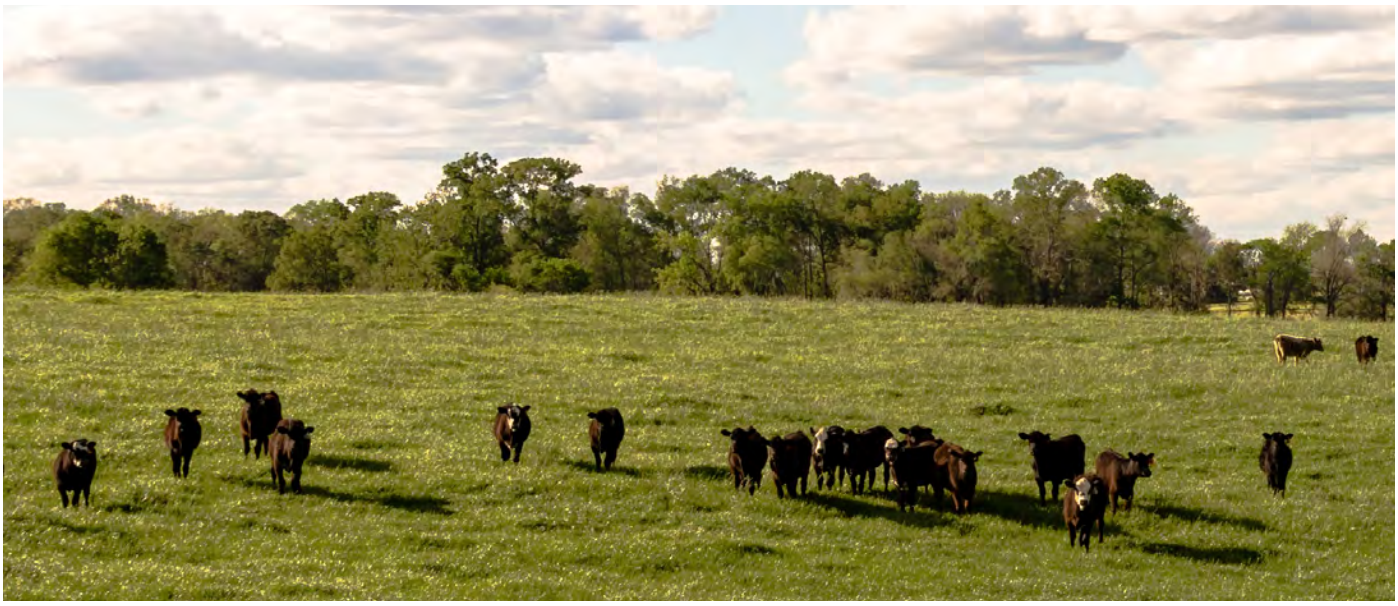
*Other cropping and farming (NAICS classification): Tobacco Farming (11191), Cotton Farming (11192), Sugarcane, Hay, Sugar Beet, Peanut, all other crops (11193 & 11194 & 11199).

**The purpose of this table is to show the NAICS category chosen for this analysis and how this industry relates to other industries in terms of the quantity of beef cow production and privately owned acreage. The Ag Census reports privately owned acres only. In some states there is a significant amount of federal land utilized by these beef cattle ranches and farms in conjunction with private land. Although not shown in this table, federal acres were incorporated into the analysis.

RESULTS - U.S. AND INDIVIDUAL STATE REPORTS

Figure 1 summarizes the total value of cattle ranching-based ecosystem services by state. Following in this document are detailed reports on the value of cattle ranching based ecosystem services for the U.S. and each individual state (excluding Alaska and Hawaii). Results are presented in terms of the total value of ecosystem services, as well as values per beef cow and per pound of retail beef.





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The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – U.S.

INTRODUCTION

The 2017 Census of Agriculture classified nearly 641,500 agricultural operations in the U.S. as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 362.5 million acres of private land, including 274.3 million acres of pasture/rangeland. They also utilized 125.9 million acres of Bureau of Land Management (BLM) land and 59.2 million acres of U.S. Forest Service (USFS) land. Combined, this land base represented more than one-third of non-metro, non-urban land in the nation and supported more than 23.5 million head of beef cows in 2017. The production from these ranches generated $34.7 billion of gross revenue including $29.4 billion from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in the U.S. was estimated to be $655.4 billion. U.S. beef cattle ranches also employed more than 2.1 million workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of U.S. beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated and expanded estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation, from pasture/rangeland used for beef cattle production in the U.S. by using 2017 Census of Agriculture data and by including estimates of the ecosystem service value of cattle grazing on federal lands. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) U.S. average per acre pasture rental rate data (NASS, 2017). Forage production values for federal rangelands associated with beef cattle ranching were calculated on a per acre basis from monthly per animal unit grazing fee rates for cattle (NASS, 2019). Specific information on the quantity of BLM grazing was obtained from the 2018 Public Land Statistics (BLM, 2019). Specific information on the quantity of USFS grazing was obtained from the FY 2016 Grazing Statistical Summary (USFS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem values of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. The total acres of federal rangeland were obtained through a GIS analysis of federal grazing allotments (Reeves, 2020). All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in the U.S. in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms

(NAICS 112111).[1] These agricultural operations account for 74 percent of the beef cows and 68 percent of the total pasture/rangeland reported in the Census of Agriculture for the U.S. The uncertainty regarding how much of the remaining 32 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and the acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of U.S. beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of federal forage production, private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in the U.S. were estimated to be $1.77, $12.50, $7.08, and $38.12 per acre, respectively. Combining these four values yields an estimated total economic value of ecosystem services for beef cattle ranching of $46.97 per acre of federal rangeland and $57.70 per acre of private pasture/rangeland. Applying these per acre values to the 185.1 million acres of federal rangeland and 274.3 million acres of private pasture/rangeland used by beef cattle ranches in the U.S. resulted in an estimated $24.5 billion in total ecosystem services provided annually. This represents an ecosystem services value of $1,043 per beef cow and $1.24 per pound of retail beef. Results were also broken down into the relative contribution of these values from federal grazing (35 percent) versus private grazing (65 percent).

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 7 percent higher than estimates from 2012 ($15.8 billion vs. $14.8 billion) due to a 7-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef declined by 10 percent using 2017 data because the number of beef cows increased by 15 percent in 2017, which more than offset the increase in private pasture/rangeland on a per-head basis. The results indicate that beef cattle ranching in the U.S. varies over time and is economically important not only from a beef production standpoint ($29.4 billion), but also from the provision of ecosystem services ($24.5 billion). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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1 Other industry classifications produce beef cattle but also have a majority of their operation in other types of livestock or production activities. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

Table 1. Value of U.S. Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values		
Federal Forage (a)	$1.77	
Private Forage (b)	$12.50	
General Services (c)	$7.08	
Wildlife Value (d)	$38.12	
Total Value Per Acre: Federal (a+c+d)	$46.97	
Total Value Per Acre: Private (b+c+d)	$57.70	
Federal Rangeland Values		
Federal Rangeland (2017 Acres)	185,116,845	
Total Value Per Acre	$46.97	
Federal Rangeland Value (e)	$8,694,251,759	
Ag. Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	274,320,871	256,861,597
Total Value Per Acre	$57.70	$57.70
Private Rangeland Value (f)	$15,827,488,944	$14,820,141,362
Total Rangeland Values (e+f)**	**$24,521,740,704**	**$23,514,393,121**
% Contribution to Total Rangeland Value		
Federal (g)	35%	37%
Private (h)	65%	63%
Beef Production Values		
Total Rangeland Values (e+f)	$24,521,740,704	$23,514,393,121
Number of Beef Cows*	23,502,870	20,404,406
Value Per Beef Cow (i)	$1,043.35	$1,152.42
Value Per Beef Cow: Federal (i × g)	$369.92	$426.10
Value Per Beef Cow: Private (i × h)	$673.43	$726.32
Value Per Beef Cow	$1,043.35	$1,152.42
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef (j)	$1.24	$1.37
Value Per LB of Beef: Federal (j × g)	$0.44	$0.51
Value Per LB of Beef: Private (j × h)	$0.80	$0.86

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture. Data limitations precluded this same comparison for federal grazing.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Alabama

INTRODUCTION

The 2017 Census of Agriculture classified nearly 18,000 agricultural operations in Alabama as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 3.4 million acres of private land, including 1.5 million acres of pasture/rangeland. This land base represented nearly 18 percent of non-metro, non-urban land in Alabama and supported nearly 543,000 head of beef cows in 2017. The production from these ranches generated $430.8 million of gross revenue, including $344.8 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $10.2 billion. Alabama beef cattle ranches also employed more than 54,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Alabama beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production by using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Alabama in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 76 percent of the beef cows and 69 percent of the total pasture/rangeland reported in the Census of Agriculture for Alabama. The uncertainty regarding how much of the remaining 31 percent of pasture/rangeland is grazed by beef cattle rather than other types

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Alabama beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Alabama were estimated to be $23.00, $16.39, and $69.88 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $109.27 per acre of private pasture/rangeland. Applying these per acre values to the 1.5 million acres of private pasture/rangeland used by beef cattle ranches in Alabama resulted in an estimated $159.8 million in total ecosystem services provided annually. This represents an ecosystem services value of $294.44 per beef cow and $0.35 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 2 percent lower than estimates from 2012 ($159.9 million vs. $162.5 million) due to a 2-percent decrease in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef increased by 2 percent using 2017 data because the number of beef cows decreased by 4 percent in 2017 which more than offset the decrease in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Alabama varies over time and is economically important not only from a beef production standpoint ($344.8 million), but also from the provision of ecosystem services ($159.8 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Alabama Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$23.00
General Services (b)	$16.39
Wildlife Value (c)	$69.88
Total Value Per Acre: Private (a+b+c)	$109.27

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	1,462,876	1,487,506
Total Value Per Acre	$109.27	$109.27
Private Rangeland Value**	$159,853,157	$162,544,557
Beef Production Values		
Total Rangeland Values	$159,853,157	$162,544,557
Number of Beef Cows*	542,907	564,373
Value Per Beef Cow	$294.44	$288.01
Value Per Beef Cow	$294.44	$288.01
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.35	$0.34

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Arizona

INTRODUCTION

The 2017 Census of Agriculture classified nearly 5,600 agricultural operations in the Arizona as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 10.4 million acres of private land, including 8.7 million acres of pasture/rangeland. They also utilized 9.2 million acres of Bureau of Land Management (BLM) land and 2.3 million acres of U.S. Forest Service (USFS) land. Combined, this land base represented 30 percent of non-metro, non-urban land in Arizona and supported over 186,000 head of beef cows in 2017. The production from these ranches generated $146.5 million of gross revenue, including $137.7 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $6.5 billion. Arizona beef cattle ranches also employed more than 21,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Arizona beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated and expanded estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data and by including estimates of the ecosystem service value of cattle grazing on federal lands. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). Forage production values for federal rangelands associated with beef cattle ranching were calculated on a per acre basis from monthly per animal unit grazing fee rates for cattle (NASS, 2019). Specific information on the quantity of BLM grazing was obtained from the 2018 Public Land Statistics (BLM, 2019). Specific information on the quantity of USFS grazing was obtained from the FY 2016 Grazing Statistical Summary (USFS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem values of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. The total acres of federal rangeland were obtained through a GIS analysis of federal grazing allotments (Reeves, 2020). All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Arizona in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms

(NAICS 112111).[1] These agricultural operations account for 93 percent of the beef cows and 39 percent of the total pasture/rangeland reported in the Census of Agriculture for Arizona. The uncertainty regarding how much of the remaining 61 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and the acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Arizona beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of federal forage production, private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Arizona were estimated to be $1.14, $2.30, $2.12, and $18.06 per acre, respectively. Combining these four values yields an estimated total economic value of ecosystem services for beef cattle ranching of $21.31 per acre of federal rangeland and $22.47 per acre of private pasture/rangeland. Applying these per acre values to the 11.5 million acres of federal rangeland and the 8.7 million acres of private pasture/rangeland used by beef cattle ranches in Arizona resulted in an estimated $440.5 million in total ecosystem services provided annually. This represents an ecosystem services value of $2,367.81 per beef cow and $2.82 per pound of retail beef. Results were also broken down into the relative contribution of these values from federal grazing (56 percent) versus private grazing (44 percent).

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 35 percent higher than estimates from 2012 ($195.8 million vs. $144.7 million) due to a 35-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef increased by only 10 percent using 2017 data because the number of beef cows increased by 2 percent in 2017, which partially offset the increase in private pasture/rangeland values on a per-head basis. The results indicate beef cattle ranching in Arizona varies over time and is economically important not only from a beef production standpoint ($137.7 million), but also from the provision of ecosystem services ($440.5 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

Table 1. Value of Arizona Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values		
Federal Forage (a)	$1.14	
Private Forage (b)	$2.30	
General Services (c)	$2.12	
Wildlife Value (d)	$18.06	
Total Value Per Acre: Federal (a+c+d)	$21.31	
Total Value Per Acre: Private (b+c+d)	$22.47	
Federal Rangeland Values		
Federal Rangeland (2017 Acres)	11,486,074	
Total Value Per Acre	$21.31	
Federal Rangeland Value (e)	$244,744,673	
Ag. Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	8,712,881	6,438,044
Total Value Per Acre	$22.47	$22.47
Private Rangeland Value (f)	$195,798,349	$144,677,562
Total Rangeland Values (e+f)**	**$440,543,022**	**$389,422,235**
% Contribution to Total Rangeland Value		
Federal (g)	56%	63%
Private (h)	44%	37%
Beef Production Values		
Total Rangeland Values (e+f)	$440,543,022	$389,422,235
Number of Beef Cows*	186,055	181,643
Value Per Beef Cow (i)	$2,367.81	$2,143.89
Value Per Beef Cow: Federal (i x g)	$1,315.44	$1,347.39
Value Per Beef Cow: Private (i x h)	$1,052.37	$796.49
Value Per Beef Cow	$2,367.81	$2,143.89
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef (j)	$2.82	$2.55
Value Per LB of Beef: Federal (j x g)	$1.56	$1.60
Value Per LB of Beef: Private (j x h)	$1.25	$0.95

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture. Data limitations precluded this same comparison for federal grazing.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Arkansas

INTRODUCTION

The 2017 Census of Agriculture classified more than 21,300 agricultural operations in Arkansas as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 4.8 million acres of private land, including 2.4 million acres of pasture/rangeland. This land base represented more than 19 percent of non-metro, non-urban land in Arkansas and supported more than 731,000 head of beef cows in 2017. The production from these ranches generated $674.7 million of gross revenue, including $619.4 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $14.2 billion. Arkansas beef cattle ranches also employed nearly 67,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Arkansas beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Arkansas in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 79 percent of the beef cows and 75 percent of the total pasture/rangeland reported in the Census of Agriculture for Arkansas. The uncertainty regarding how much of the remaining 25 percent of pasture/rangeland is grazed by beef cattle rather than other types

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Arkansas beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Arkansas were estimated to be $18.00, $13.68, and $47.45 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $79.13 per acre of private pasture/rangeland. Applying these per acre values to the 2.4 million acres of private pasture/rangeland used by beef cattle ranches in Arkansas resulted in an estimated $189.1 million in total ecosystem services provided annually. This represents an ecosystem services value of $258.55 per beef cow and $0.31 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 4 percent higher than estimates from 2012 ($189.1 million vs. $181.1 million) due to a 4-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 6 percent using 2017 data because the number of beef cows increased by 11 percent in 2017, which more than offset the increased in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Arkansas varies over time and is economically important not only from a beef production standpoint ($619.4 million), but also from the provision of ecosystem services ($189.1 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Arkansas Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$18.00
General Services (b)	$13.68
Wildlife Value (c)	$47.45
Total Value Per Acre: Private (a+b+c)	$79.13

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	2,390,100	2,289,276
Total Value Per Acre	$79.13	$79.13
Private Rangeland Value**	$189,116,991	$181,139,278
Beef Production Values		
Total Rangeland Values	$189,116,991	$181,139,278
Number of Beef Cows*	731,459	662,099
Value Per Beef Cow	$258.55	$273.58
Value Per Beef Cow	$258.55	$273.58
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.31	$0.33

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – California

INTRODUCTION

The 2017 Census of Agriculture classified more than 10,300 agricultural operations in the California as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 10.5 million acres of private land, including 8.6 million acres of pasture/rangeland. They also utilized 3.6 million acres of Bureau of Land Management (BLM) land and 7.0 million acres of U.S. Forest Service (USFS) land. Combined, this land base represented 22 percent of non-metro, non-urban land in California and supported nearly 563,000 head of beef cows in 2017. The production from these ranches generated $1.3 billion of gross revenue, including $1.2 billion from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $29.7 billion. California beef cattle ranches also employed close to 37,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of California beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated and expanded estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data and by including estimates of the ecosystem service value of cattle grazing on federal lands. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). Forage production values for federal rangelands associated with beef cattle ranching were calculated on a per acre basis from monthly per animal unit grazing fee rates for cattle (NASS, 2019). Specific information on the quantity of BLM grazing was obtained from the 2018 Public Land Statistics (BLM, 2019). Specific information on the quantity of USFS grazing was obtained from the FY 2016 Grazing Statistical Summary (USFS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem values of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. The total acres of federal rangeland were obtained through a GIS analysis of federal grazing allotments (Reeves, 2020). All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in California in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms

(NAICS 112111).[1] These agricultural operations account for 82 percent of the beef cows and 74 percent of the total pasture/rangeland reported in the Census of Agriculture for California. The uncertainty regarding how much of the remaining 26 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and the acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of California beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of federal forage production, private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in California were estimated to be $1.00, $12.00, $10.57, and $29.16 per acre, respectively. Combining these four values yields an estimated total economic value of ecosystem services for beef cattle ranching of $40.74 per acre of federal rangeland and $51.74 per acre of private pasture/rangeland. Applying these per acre values to the 10.6 million acres of federal rangeland and the 8.6 million acres of private pasture/rangeland used by beef cattle ranches in California resulted in an estimated $873.7 million in total ecosystem services provided annually. This represents an ecosystem services value of $1,553.03 per beef cow and $1.85 per pound of retail beef. Results were also broken down into the relative contribution of these values from federal grazing (49 percent) versus private grazing (51 percent).

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 3 percent lower than estimates from 2012 ($443.9 million vs. $457.1 million) due to a 3-percent decrease in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef declined by 17 percent using 2017 data because the number of beef cows increased by 19 percent in 2017, which amplified the decrease in private pasture/rangeland values on a per-head basis. The results indicate beef cattle ranching in California varies over time and is economically important not only from a beef production standpoint ($1.2 billion), but also from the provision of ecosystem services ($873.7 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

Table 1. Value of California Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values		
Federal Forage (a)	$1.00	
Private Forage (b)	$12.00	
General Services (c)	$10.57	
Wildlife Value (d)	$29.16	
Total Value Per Acre: Federal (a+c+d)	$40.74	
Total Value Per Acre: Private (b+c+d)	$51.74	
Federal Rangeland Values		
Federal Rangeland (2017 Acres)	10,550,271	
Total Value Per Acre	$40.74	
Federal Rangeland Value (e)	$429,803,362	
Ag. Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	8,579,820	8,836,126
Total Value Per Acre	$51.74	$51.74
Private Rangeland Value (f)	$443,887,259	$457,147,557
Total Rangeland Values (e+f)**	**$873,690,621**	**$886,950,919**
% Contribution to Total Rangeland Value		
Federal (g)	49%	48%
Private (h)	51%	52%
Beef Production Values		
Total Rangeland Values (e+f)	$873,690,621	$886,950,919
Number of Beef Cows*	562,571	472,769
Value Per Beef Cow (i)	$1,553.03	$1,876.08
Value Per Beef Cow: Federal (i × g)	$764.00	$909.12
Value Per Beef Cow: Private (i × h)	$789.03	$966.96
Value Per Beef Cow	$1,553.03	$1,876.08
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef (j)	$1.85	$2.23
Value Per LB of Beef: Federal (j × g)	$0.91	$1.08
Value Per LB of Beef: Private (j × h)	$0.94	$1.15

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture. Data limitations precluded this same comparison for federal grazing.

The Economic Value of Beef Cattle Ranching Based Ecosystem Services – Colorado

INTRODUCTION

The 2017 Census of Agriculture classified nearly 12,300 agricultural operations in the Colorado as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 15.1 million acres of private land, including 12.5 million acres of pasture/rangeland. They also utilized 5.7 million acres of Bureau of Land Management (BLM) land and 7.3 million acres of U.S. Forest Service (USFS) land. Combined, this land base represented 55 percent of non-metro, non-urban land in Colorado and supported more than 628,000 head of beef cows in 2017. The production from these ranches generated $981.4 million of gross revenue, including $844.1 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $19.0 billion. Colorado beef cattle ranches also employed more than 46,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Colorado beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated and expanded estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data and by including estimates of the ecosystem service value of cattle grazing on federal lands. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). Forage production values for federal rangelands associated with beef cattle ranching were calculated on a per acre basis from monthly per animal unit grazing fee rates for cattle (NASS, 2019). Specific information on the quantity of BLM grazing was obtained from the 2018 Public Land Statistics (BLM, 2019). Specific information on the quantity of USFS grazing was obtained from the FY 2016 Grazing Statistical Summary (USFS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem values of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. The total acres of federal rangeland were obtained through a GIS analysis of federal grazing allotments (Matt Reeves, 2020). All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Colorado in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only con-

siders the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 78 percent of the beef cows and 66 percent of the total pasture/rangeland reported in the Census of Agriculture for Colorado. The uncertainty regarding how much of the remaining 34 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and the acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Colorado beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of federal forage production, private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Colorado were estimated to be $1.43, $5.60, $4.28, and $18.07 per acre, respectively. Combining these four values yields an estimated total economic value of ecosystem services for beef cattle ranching of $23.78 per acre of federal rangeland and $27.95 per acre of private pasture/rangeland. Applying these per acre values to the 13.0 million acres of federal rangeland and the 12.4 million acres of private pasture/rangeland used by beef cattle ranches in Colorado resulted in an estimated $656.7 million in total ecosystem services provided annually. This represents an ecosystem services value of $1,045.21 per beef cow and $1.24 per pound of retail beef. Results were also broken down into the relative contribution of these values from federal grazing (47 percent) versus private grazing (53 percent).

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 3 percent higher than estimates from 2012 ($347.9 million vs. $338.1 million) due to a 3-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef declined by 18 percent using 2017 data because the number of beef cows increased by 23 percent in 2017, which more than offset the increase in private pasture/rangeland values on a per-head basis. The results indicate beef cattle ranching in Colorado varies over time and is economically important not only from a beef production standpoint ($844.1 million), but also from the provision of ecosystem services ($656.7 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

Table 1. Value of Colorado Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values		
Federal Forage (a)	$1.43	
Private Forage (b)	$5.60	
General Services (c)	$4.28	
Wildlife Value (d)	$18.07	
Total Value Per Acre: Federal (a+c+d)	$23.78	
Total Value Per Acre: Private (b+c+d)	$27.95	
Federal Rangeland Values		
Federal Rangeland (2017 Acres)	12,982,150	
Total Value Per Acre	$23.78	
Federal Rangeland Value (e)	$308,753,510	
Ag. Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	12,446,044	12,096,221
Total Value Per Acre	$27.95	$27.95
Private Rangeland Value (f)	$347,915,069	$338,136,163
Total Rangeland Values (e+f)**	**$656,668,579**	**$646,889,673**
% Contribution to Total Rangeland Value		
Federal (g)	47%	48%
Private (h)	53%	52%
Beef Production Values		
Total Rangeland Values (e+f)	$656,668,579	$646,889,673
Number of Beef Cows*	628,262	510,047
Value Per Beef Cow (i)	$1,045.21	$1,268.29
Value Per Beef Cow: Federal (i x g)	$491.44	$605.34
Value Per Beef Cow: Private (i x h)	$553.77	$662.95
Value Per Beef Cow	$1,045.21	$1,268.29
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef (j)	$1.24	$1.51
Value Per LB of Beef: Federal (j x g)	$0.58	$0.72
Value Per LB of Beef: Private (j x h)	$0.66	$0.79

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture. Data limitations precluded this same comparison for federal grazing.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Connecticut

INTRODUCTION

The 2017 Census of Agriculture classified over 600 agricultural operations in Connecticut as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 7,183 acres of pasture/rangeland. This land base supported nearly 3,500 head of beef cows in 2017. Connecticut beef cattle ranches also employed more than 2,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Connecticut beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation, from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Connecticut in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 54 percent of the beef cows and 23 percent of the total pasture/rangeland reported in the Census of Agriculture for Connecticut. The uncertainty regarding how much of the remaining 77 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

RESULTS

Table 1 summarizes the value of Connecticut beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Connecticut were estimated to be $25.75, $16.64, and $202.27 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $244.66 per acre of private pasture/rangeland. Applying these per acre values to the 7,183 acres of private pasture/rangeland used by beef cattle ranches in Connecticut resulted in an estimated $1.8 million in total ecosystem services provided annually. This represents an ecosystem services value of $505.15 per beef cow and $0.60 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 9 percent lower than estimates from 2012 ($1.8 million vs. $1.9 million) due to a 9-percent decrease in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef increased by 3 percent using 2017 data because the number of beef cows decreased by 12 percent in 2017, which more than offset the decrease in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Connecticut varies over time and is economically important not only from a beef production standpoint, but also from the provision of ecosystem services ($1.8 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Connecticut Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$25.75
General Services (b)	$16.64
Wildlife Value (c)	$202.27
Total Value Per Acre: Private (a+b+c)	$244.66

Ag. Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	7,183	7,907
Total Value Per Acre	$244.66	$244.66
Private Rangeland Value**	$1,757,419	$1,934,555
Beef Production Values		
Total Rangeland Values	$1,757,419	$1,934,555
Number of Beef Cows*	3,479	3,956
Value Per Beef Cow	$505.15	$489.02
Value Per Beef Cow	$505.15	$489.02
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.60	$0.58

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Delaware

INTRODUCTION

The 2017 Census of Agriculture classified over 150 agricultural operations in Delaware as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 2,164 acres of pasture/rangeland. This land base supported nearly 800 head of beef cows in 2017. The production from these ranches generated $83,000 of gross revenue. Delaware beef cattle ranches also employed more than 560 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Delaware beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation, from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Delaware in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 32 percent of the beef cows and 26 percent of the total pasture/rangeland reported in the Census of Agriculture for Delaware. The uncertainty regarding how much of the remaining 74 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

1 Other agricultural classifications produce beef cattle but also have majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

RESULTS

Table 1 summarizes the value of Delaware beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Delaware were estimated to be $36.00, $29.37, and $73.38 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $138.75 per acre of private pasture/rangeland. Applying these per acre values to the 2,164 acres of private pasture/rangeland used by beef cattle ranches in Delaware resulted in an estimated $300,249 in total ecosystem services provided annually. This represents an ecosystem services value of $393.79 per beef cow and $0.47 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 126 percent higher than estimates from 2012 ($300,249 vs. $132,642) due to a 126-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef increased by 161 percent using 2017 data because the number of beef cows decreased by 13 percent in 2017, which amplified the increase in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Delaware varies over time and is economically important not only from a beef production standpoint, but also from the provision of ecosystem services ($300,249). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Delaware Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$36.00
General Services (b)	$29.37
Wildlife Value (c)	$73.38
Total Value Per Acre: Private (a+b+c)	$138.75

Ag. Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	2,164	956
Total Value Per Acre	$138.75	$138.75
Private Rangeland Value**	$300,249	$132,642
Beef Production Values		
Total Rangeland Values	$300,249	$132,642
Number of Beef Cows*	762	880
Value Per Beef Cow	$393.79	$150.73
Value Per Beef Cow	$393.79	$150.73
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.47	$0.18

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Florida

INTRODUCTION

The 2017 Census of Agriculture classified more than 18,500 agricultural operations in Florida as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 5.0 million acres of private land, including 2.7 million acres of pasture/rangeland. This land base represented nearly 15 percent of non-urban land in Florida and supported over 721,000 head of beef cows in 2017. The production from these ranches generated $446.6 million of gross revenue, including $398.9 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $24.5 billion. Florida beef cattle ranches also employed more than 59,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Florida beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Florida in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 82 percent of the beef cows and 73 percent of the total pasture/rangeland reported in the Census of Agriculture for Florida. The uncertainty regarding how much of the remaining 27 percent of pasture/rangeland is grazed by beef cattle rather than other types

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Florida beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Florida were estimated to be $15.50, $13.19, and $56.56 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $85.25 per acre of private pasture/rangeland. Applying these per acre values to the 2.7 million acres of private pasture/rangeland used by beef cattle ranches in Florida resulted in an estimated $226.4 million in total ecosystem services provided annually. This represents an ecosystem services value of $313.88 per beef cow and $0.37 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 1 percent lower than estimates from 2012 ($226.4 million vs. $228.1 million) due to a 1-percent decrease in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef increased by 9 percent using 2017 data because the number of beef cows decreased by 9 percent in 2017, which more than offset the decrease in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Florida varies over time and is economically important not only from a beef production standpoint ($398.9 million), but also from the provision of ecosystem services ($226.4 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Florida Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$15.50
General Services (b)	$13.19
Wildlife Value (c)	$56.56
Total Value Per Acre: Private (a+b+c)	$85.25

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	2,655,991	2,676,248
Total Value Per Acre	$85.25	$85.25
Private Rangeland Value**	$226,414,450	$228,141,292
Beef Production Values		
Total Rangeland Values	$226,414,450	$228,141,292
Number of Beef Cows*	721,342	788,767
Value Per Beef Cow	$313.88	$289.24
Value Per Beef Cow	$313.88	$289.24
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.37	$0.34

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Georgia

INTRODUCTION

The 2017 Census of Agriculture classified more than 13,200 agricultural operations in Georgia as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 781,924 acres of pasture/rangeland. This land base supported more than 317,000 head of beef cows in 2017. The production from these ranches generated $287.3 million of gross revenue, including $239.1 million from the sale of cattle and calves. Georgia beef cattle ranches also employed more than 40,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Georgia beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation, from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Georgia in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 65 percent of the beef cows and 59 percent of the total pasture/rangeland reported in the Census of Agriculture for Georgia. The uncertainty regarding how much of the remaining 41 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

RESULTS

Table 1 summarizes the value of Georgia beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Georgia were estimated to be $29.00, $22.12, and $125.35 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $176.47 per acre of private pasture/rangeland. Applying these per acre values to the 781,924 acres of private pasture/rangeland used by beef cattle ranches in Georgia resulted in an estimated $138.0 million in total ecosystem services provided annually. This represents an ecosystem services value of $434.70 per beef cow and $0.52 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 5 percent higher than estimates from 2012 ($138.0 million vs. $131.0 million) due to a 5-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 2 percent using 2017 data because the number of beef cows increased by 7 percent in 2017, which more than offset the increase in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Georgia varies over time and is economically important not only from a beef production standpoint ($239.1 million), but also from the provision of ecosystem services ($138.0 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Georgia Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$29.00
General Services (b)	$22.12
Wildlife Value (c)	$125.35
Total Value Per Acre: Private (a+b+c)	$176.47

Ag. Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	781,924	742,425
Total Value Per Acre	$176.47	$176.47
Private Rangeland Value**	$137,983,973	$131,013,693
Beef Production Values		
Total Rangeland Values	$137,983,973	$131,013,693
Number of Beef Cows*	317,421	296,826
Value Per Beef Cow	$434.70	$441.38
Value Per Beef Cow	$434.70	$441.38
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.52	$0.52

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Idaho

Introduction

The 2017 Census of Agriculture classified more than 8,100 agricultural operations in the Idaho as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 3.7 million acres of private land, including 2.8 million acres of pasture/rangeland. They also utilized 9.5 million acres of Bureau of Land Management (BLM) land and 6.7 million acres of U.S. Forest Service (USFS) land. Combined, this land base represented nearly 50 percent of non-metro, non-urban land in Idaho and supported close to 369,000 head of beef cows in 2017. The production from these ranches generated $831.9 million of gross revenue, including $742.0 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $7.9 billion. Idaho beef cattle ranches also employed over 30,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Idaho beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated and expanded estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data and by including estimates of the ecosystem service value of cattle grazing on federal lands. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). Forage production values for federal rangelands associated with beef cattle ranching were calculated on a per acre basis from monthly per animal unit grazing fee rates for cattle (NASS, 2019). Specific information on the quantity of BLM grazing was obtained from the 2018 Public Land Statistics (BLM, 2019). Specific information on the quantity of USFS grazing was obtained from the FY 2016 Grazing Statistical Summary (USFS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem values of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. The total acres of federal rangeland were obtained through a GIS analysis of federal grazing allotments (Reeves, 2020). All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Idaho in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms

(NAICS 112111).[1] These agricultural operations account for 74 percent of the beef cows and 57 percent of the total pasture/rangeland reported in the Census of Agriculture for Idaho. The uncertainty regarding how much of the remaining 43 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and the acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Idaho beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of federal forage production, private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Idaho were estimated to be $1.58, $12.00, $10.62, and $13.63 per acre, respectively. Combining these four values yields an estimated total economic value of ecosystem services for beef cattle ranching of $25.83 per acre of federal rangeland and $36.25 per acre of private pasture/rangeland. Applying these per acre values to the 16.1 million acres of federal rangeland and the 2.8 million acres of private pasture/rangeland used by beef cattle ranches in Idaho resulted in an estimated $517.0 million in total ecosystem services provided annually. This represents an ecosystem services value of $1,402.24 per beef cow and $1.67 per pound of retail beef. Results were also broken down into the relative contribution of these values from federal grazing (81 percent) versus private grazing (19 percent).

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 11 percent higher than estimates from 2012 ($100.2 million vs. $89.9 million) due to an 11-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef declined by 4 percent using 2017 data because the number of beef cows increased by 7 percent in 2017, which more than offset the increase in private pasture/rangeland values on a per-head basis. The results indicate beef cattle ranching in Idaho varies over time and is economically important not only from a beef production standpoint ($742.0 million), but also from the provision of ecosystem services ($517.0 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

Table 1. Value of Idaho Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values		
Federal Forage (a)	$1.58	
Private Forage (b)	$12.00	
General Services (c)	$10.62	
Wildlife Value (d)	$13.63	
Total Value Per Acre: Federal (a+c+d)	$25.83	
Total Value Per Acre: Private (b+c+d)	$36.25	
Federal Rangeland Values		
Federal Rangeland (2017 Acres)	16,134,180	
Total Value Per Acre	$25.83	
Federal Rangeland Value (e)	$416,764,473	
Ag. Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	2,763,708	2,481,133
Total Value Per Acre	$36.25	$36.25
Private Rangeland Value (f)	$100,187,563	$89,943,897
Total Rangeland Values (e+f)**	**$516,952,036**	**$506,708,370**
% Contribution to Total Rangeland Value		
Federal (g)	81%	82%
Private (h)	19%	18%
Beef Production Values		
Total Rangeland Values (e+f)	$516,952,036	$506,708,370
Number of Beef Cows*	368,661	345,445
Value Per Beef Cow (i)	$1,402.24	$1,466.83
Value Per Beef Cow: Federal (i × g)	$1,130.48	$1,206.46
Value Per Beef Cow: Private (i × h)	$271.76	$260.37
Value Per Beef Cow	$1,402.24	$1,466.83
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef (j)	$1.67	$1.74
Value Per LB of Beef: Federal (j × g)	$1.34	$1.43
Value Per LB of Beef: Private (j × h)	$0.32	$0.31

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture. Data limitations precluded this same comparison for federal grazing.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Illinois

INTRODUCTION

The 2017 Census of Agriculture classified more than 6,700 agricultural operations in Illinois as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 641,494 acres of private land, including 228,782 acres of pasture/rangeland. This land base represented 3 percent of non-metro, non-urban land in Illinois and supported more than 117,000 head of beef cows in 2017. The production from these ranches generated $244.5 million of gross revenue, including $183.0 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $4.0 billion. Illinois beef cattle ranches also employed more than 20,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Illinois beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Illinois in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported om the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 30 percent of the beef cows and 28 percent of the total pasture/rangeland reported in the Census of Agriculture for Illinois. The uncertainty regarding how much of the remaining 72 percent of pasture/rangeland is grazed by beef cattle rather than other types

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Illinois beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Illinois were estimated to be $38.00, $24.40, and $80.37 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $142.77 per acre of private pasture/rangeland. Applying these per acre values to the 228,782 acres of private pasture/rangeland used by beef cattle ranches in Illinois resulted in an estimated $32.7 million in total ecosystem services provided annually. This represents an ecosystem services value of $278.49 per beef cow and $0.33 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 4 percent higher than estimates from 2012 ($32.7 million vs. $31.5 million) due to a 4-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef increased by 1 percent using 2017 data because the number of beef cows increased by 3 percent in 2017, which resulted in a smaller increase on a per-head basis. The results indicate beef cattle ranching in Illinois varies over time and is economically important not only from a beef production standpoint ($183.0 million), but also from the provision of ecosystem services ($32.7 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Illinois Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$38.00
General Services (b)	$24.40
Wildlife Value (c)	$80.37
Total Value Per Acre: Private (a+b+c)	$142.77

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	228,782	220,732
Total Value Per Acre	$142.77	$142.77
Private Rangeland Value**	$32,662,918	$31,513,629
Beef Production Values		
Total Rangeland Values	$32,662,918	$31,513,629
Number of Beef Cows*	117,287	114,224
Value Per Beef Cow	$278.49	$275.89
Value Per Beef Cow	$278.49	$275.89
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.33	$0.33

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Indiana

INTRODUCTION

The 2017 Census of Agriculture classified 8,500 agricultural operations in Indiana as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 604,420 acres of private land, including 188,236 acres of pasture/rangeland. This land base represented 5 percent of non-metro, non-urban land in Indiana and supported nearly 97,000 head of beef cows in 2017. The production from these ranches generated $251.6 million of gross revenue, including $213.2 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $3.9 billion. Indiana beef cattle ranches also employed nearly 29,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Indiana beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Indiana in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 46 percent of the beef cows and 37 percent of the total pasture/rangeland reported in the Census of Agriculture for Indiana. The uncertainty regarding how much of the remaining 63 percent of pasture/rangeland is grazed by beef cattle rather than other types

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Indiana beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Indiana were estimated to be $39.00, $25.76, and $190.02 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $254.78 per acre of private pasture/rangeland. Applying these per acre values to the 188,236 acres of private pasture/rangeland used by beef cattle ranches in Indiana resulted in an estimated $48.0 million in total ecosystem services provided annually. This represents an ecosystem services value of $496.89 per beef cow and $0.59 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 7 percent higher than estimates from 2012 ($48.0 million vs. $44.8 million) due to a 7-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 6 percent using 2017 data because the number of beef cows increased by 14 percent in 2017, which more than offset the increase in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Indiana varies over time and is economically important not only from a beef production standpoint ($213.2 million), but also from the provision of ecosystem services ($48.0 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Indiana Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$39.00
General Services (b)	$25.76
Wildlife Value (c)	$190.02
Total Value Per Acre: Private (a+b+c)	$254.78

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	188,236	175,847
Total Value Per Acre	$254.78	$254.78
Private Rangeland Value**	$47,959,072	$44,802,583
Beef Production Values		
Total Rangeland Values	$47,959,072	$44,802,583
Number of Beef Cows*	96,519	84,878
Value Per Beef Cow	$496.89	$527.85
Value Per Beef Cow	$496.89	$527.85
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.59	$0.63

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Iowa

INTRODUCTION

The 2017 Census of Agriculture classified more than 10,400 agricultural operations in Iowa as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 1.7 million acres of private land, including 571,828 acres of pasture/rangeland. This land base represented more than 6 percent of non-metro, non-urban land in Iowa and supported more than 332,000 head of beef cows in 2017. The production from these ranches generated $1.3 billion of gross revenue, including $942.3 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $10.0 billion. Iowa beef cattle ranches also employed nearly 34,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Iowa beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Iowa in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 35 percent of the beef cows and 32 percent of the total pasture/rangeland reported in the Census of Agriculture for Iowa. The uncertainty regarding how much of the remaining 68 percent of pasture/rangeland is grazed by beef cattle rather than other types

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Iowa beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Iowa were estimated to be $54.00, $37.66, and $20.66 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $112.31 per acre of private pasture/rangeland. Applying these per acre values to the 571,828 acres of private pasture/rangeland used by beef cattle ranches in Iowa resulted in an estimated $64.2 million in total ecosystem services provided annually. This represents an ecosystem services value of $193.19 per beef cow and $0.23 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 8 percent higher than estimates from 2012 ($64.2 million vs. $59.3 million) due to an 8-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 7 percent using 2017 data because the number of beef cows increased by 17 percent in 2017, which more than offset the increase in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Iowa varies over time and is economically important not only from a beef production standpoint ($942.3 million), but also from the provision of ecosystem services ($64.2 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Iowa Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$54.00
General Services (b)	$37.66
Wildlife Value (c)	$20.66
Total Value Per Acre: Private (a+b+c)	$112.31

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	571,828	528,440
Total Value Per Acre	$112.31	$112.31
Private Rangeland Value**	$64,222,262	$59,349,336
Beef Production Values		
Total Rangeland Values	$64,222,262	$59,349,336
Number of Beef Cows*	332,428	284,694
Value Per Beef Cow	$193.19	$208.47
Value Per Beef Cow	$193.19	$208.47
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.23	$0.25

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Kansas

INTRODUCTION

The 2017 Census of Agriculture classified nearly 17,300 agricultural operations in the Kansas as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 11.4 million acres of private land, including 7.5 million acres of pasture/rangeland. They also utilized 100,530 acres of U.S. Forest Service (USFS) land. Combined, this land base represented 26 percent of non-metro, non-urban land in Kansas and supported more than 834,000 head of beef cows in 2017. The production from these ranches generated $2.6 billion of gross revenue, including $2.2 billion from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $21.2 billion. Kansas beef cattle ranches also employed more than 55,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Kansas beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated and expanded estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data and by including estimates of the ecosystem service value of cattle grazing on federal lands. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). Forage production values for federal rangelands associated with beef cattle ranching were calculated on a per acre basis from monthly per animal unit grazing fee rates for cattle (NASS, 2019). Specific information on the quantity of Bureau of Land Management (BLM) grazing was obtained from the 2018 Public Land Statistics (BLM, 2019). Specific information on the quantity of USFS grazing was obtained from the FY 2016 Grazing Statistical Summary (USFS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem values of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. The total acres of federal rangeland were obtained through a GIS analysis of federal grazing allotments (Reeves, 2020). All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Kansas in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms

(NAICS 112111).[1] These agricultural operations account for 56 percent of the beef cows and 51 percent of the total pasture/rangeland reported in the Census of Agriculture for Kansas. The uncertainty regarding how much of the remaining 49 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and the acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Kansas beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of federal forage production, private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Kansas were estimated to be $5.41, $19.00, $13.42, and $14.29 per acre, respectively. Combining these four values yields an estimated total economic value of ecosystem services for beef cattle ranching of $33.12 per acre of federal rangeland and $46.71 per acre of private pasture/rangeland. Applying these per acre values to the 100,530 acres of federal rangeland and the 7.5 million acres of private pasture/rangeland used by beef cattle ranches in Kansas resulted in an estimated $355.0 million in total ecosystem services provided annually. This represents an ecosystem services value of $425.69 per beef cow and $0.51 per pound of retail beef. Results were also broken down into the relative contribution of these values from federal grazing (1 percent) versus private grazing (99 percent).

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 7 percent higher than estimates from 2012 ($351.7 million vs. $328.8 million) due to a 7-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef declined by 19 percent using 2017 data because the number of beef cows increased by 32 percent in 2017, which more than offset the increase in private pasture/rangeland values on a per-head basis. The results indicate beef cattle ranching in Kansas varies over time and is economically important not only from a beef production standpoint ($2.2 billion), but also from the provision of ecosystem services ($355.0 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

Table 1. Value of Kansas Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values		
Federal Forage (a)	$5.41	
Private Forage (b)	$19.00	
General Services (c)	$13.42	
Wildlife Value (d)	$14.29	
Total Value Per Acre: Federal (a+c+d)	$33.12	
Total Value Per Acre: Private (b+c+d)	$46.71	
Federal Rangeland Values		
Federal Rangeland (2017 Acres)	100,530	
Total Value Per Acre	$33.12	
Federal Rangeland Value (e)	$3,330,064	
Ag. Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	7,529,646	7,038,339
Total Value Per Acre	$46.71	$46.71
Private Rangeland Value (f)	$351,718,204	$328,768,703
Total Rangeland Values (e+f)**	**$355,048,268**	**$332,098,767**
% Contribution to Total Rangeland Value		
Federal (g)	1%	1%
Private (h)	99%	99%
Beef Production Values		
Total Rangeland Values (e+f)	$355,048,268	$332,098,767
Number of Beef Cows*	834,044	630,140
Value Per Beef Cow (i)	$425.69	$527.02
Value Per Beef Cow: Federal (i × g)	$3.99	$5.28
Value Per Beef Cow: Private (i × h)	$421.70	$521.74
Value Per Beef Cow	$425.69	$527.02
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef (j)	$0.51	$0.63
Value Per LB of Beef: Federal (j × g)	$0.00	$0.01
Value Per LB of Beef: Private (j × h)	$0.50	$0.62

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture. Data limitations precluded this same comparison for federal grazing.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Kentucky

INTRODUCTION

The 2017 Census of Agriculture classified nearly 30,600 agricultural operations in Kentucky as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 4.8 million acres of private land, including 2.0 million acres of pasture/rangeland. This land base represented more than 25 percent of non-metro, non-urban land in Kentucky and supported nearly 784,000 head of beef cows in 2017. The production from these ranches generated $932.4 million of gross revenue, including $805.4 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $16.8 billion. Kentucky beef cattle ranches also employed more than 96,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Kentucky beef cattle ranching -based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Kentucky in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 76 percent of the beef cows and 66 percent of the total pasture/rangeland reported in the Census of Agriculture for Kentucky. The uncertainty regarding how much of the remaining 34 percent of pasture/rangeland is grazed by beef cattle rather than other

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

types of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Kentucky beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Kentucky were estimated to be $25.00, $21.11, and $57.11 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $103.21 per acre of private pasture/rangeland. Applying these per acre values to the 2.0 million acres of private pasture/rangeland used by beef cattle ranches in Kentucky resulted in an estimated $202.2 million in total ecosystem services provided annually. This represents an ecosystem services value of $258.04 per beef cow and $0.31 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 2 percent higher than estimates from 2012 ($202.2 million vs. $197.6 million) due to a 2-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 7 percent using 2017 data because the number of beef cows increased by 10 percent in 2017, which more than offset the increase in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Kentucky varies over time and is economically important not only from a beef production standpoint ($805.4 million), but also from the provision of ecosystem services ($202.2 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Kentucky Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$25.00
General Services (b)	$21.11
Wildlife Value (c)	$57.11
Total Value Per Acre: Private (a+b+c)	$103.21

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	1,959,362	1,914,193
Total Value Per Acre	$103.21	$103.21
Private Rangeland Value**	$202,233,695	$197,571,620
Beef Production Values		
Total Rangeland Values	$202,233,695	$197,571,620
Number of Beef Cows*	783,722	715,465
Value Per Beef Cow	$258.04	$276.14
Value Per Beef Cow	$258.04	$276.14
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.31	$0.33

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Louisiana

INTRODUCTION

The 2017 Census of Agriculture classified nearly 11,600 agricultural operations in Louisiana as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 1.3 million acres of pasture/rangeland. This land base supported more than 403,000 head of beef cows in 2017. The production from these ranches generated $258.8 million of gross revenue, including $225.2 million from the sale of cattle and calves. Louisiana beef cattle ranches also employed more than 37,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Louisiana beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation, from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Louisiana in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 86 percent of the beef cows and 78 percent of the total pasture/rangeland reported in the Census of Agriculture for Louisiana. The uncertainty regarding how much of the remaining 22 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

RESULTS

Table 1 summarizes the value of Louisiana beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Louisiana were estimated to be $17.00, $13.05, and $34.06 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $64.11 per acre of private pasture/rangeland. Applying these per acre values to the 1.3 million acres of private pasture/rangeland used by beef cattle ranches in Louisiana resulted in an estimated $84.1 million in total ecosystem services provided annually. This represents an ecosystem services value of $208.56 per beef cow and $0.25 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 6 percent higher than estimates from 2012 ($84.1 million vs. $79.7 million) due to a 6-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 9 percent using 2017 data because the number of beef cows increased by 16 percent in 2017, which more than offset the increase in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Louisiana varies over time and is economically important not only from a beef production standpoint ($225.2 million), but also from the provision of ecosystem services ($84.1 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Louisiana Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$17.00
General Services (b)	$13.05
Wildlife Value (c)	$34.06
Total Value Per Acre: Private (a+b+c)	$64.11

Ag. Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	1,312,377	1,243,228
Total Value Per Acre	$64.11	$64.11
Private Rangeland Value**	$84,141,886	$79,708,459
Beef Production Values		
Total Rangeland Values	$84,141,886	$79,708,459
Number of Beef Cows*	403,450	346,983
Value Per Beef Cow	$208.56	$229.72
Value Per Beef Cow	$208.56	$229.72
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.25	$0.27

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Maine

INTRODUCTION

The 2017 Census of Agriculture classified nearly 800 agricultural operations in Maine as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 91,941 acres of private land, including 12,755 acres of pasture/rangeland. This land base represented approximately 0.5 percent of non-metro, non-urban land in Maine and supported more than 5,000 head of beef cows in 2017. The production from these ranches generated $7.5 million of gross revenue, including $5.5 million from the sale of cattle and calves. Maine beef cattle ranches also employed close to 3,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Maine beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Maine in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 49 percent of the beef cows and 20 percent of the total pasture/rangeland reported in the Census of Agriculture for Maine. The uncertainty regarding how much of the remaining 80 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

RESULTS

Table 1 summarizes the value of Maine beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Maine were estimated to be $25.75, $17.62, and $37.92 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $81.29 per acre of private pasture/rangeland. Applying these per acre values to the 12,755 acres of private pasture/rangeland used by beef cattle ranches in Maine resulted in an estimated $1.0 million in total ecosystem services provided annually. This represents an ecosystem services value of $204.07 per beef cow and $0.24 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 17 percent lower than estimates from 2012 ($1.0 million vs. $1.3 million) due to a 17-percent decrease in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 20 percent using 2017 data because the number of beef cows increased by 4 percent in 2017, which amplified the decrease in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Maine varies over time and is economically important not only from a beef production standpoint ($5.5 million), but also from the provision of ecosystem services ($1.0 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Maine Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$25.75
General Services (b)	$17.62
Wildlife Value (c)	$37.92
Total Value Per Acre: Private (a+b+c)	$81.29

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	12,755	15,416
Total Value Per Acre	$81.29	$81.29
Private Rangeland Value**	$1,036,879	$1,253,197
Beef Production Values		
Total Rangeland Values	$1,036,879	$1,253,197
Number of Beef Cows*	5,081	4,894
Value Per Beef Cow	$204.07	$256.07
Value Per Beef Cow	$204.07	$256.07
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.24	$0.30

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Maryland

INTRODUCTION

The 2017 Census of Agriculture classified nearly 1,600 agricultural operations in Maryland as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 115,358 acres of private land, including 32,455 acres of pasture/rangeland. This land base represented over 2 percent of non-urban land in Maryland and supported nearly 20,000 head of beef cows in 2017. The production from these ranches generated $31.3 million of gross revenue, including $24.3 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $1.2 billion. Maryland beef cattle ranches also employed more than 5,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Maryland beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation, from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Maryland in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 41 percent of the beef cows and 24 percent of the total pasture/rangeland reported in the Census of Agriculture for Maryland. The uncertainty regarding how much of the remaining 76 percent of pasture/rangeland is grazed by beef cattle rather than other

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

types of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Maryland beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Maryland were estimated to be $40.00, $29.28, and $88.37 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $157.65 per acre of private pasture/rangeland. Applying these per acre values to the 32,455 acres of private pasture/rangeland used by beef cattle ranches in Maryland resulted in an estimated $5.1 million in total ecosystem services provided annually. This represents an ecosystem services value of $258.88 per beef cow and $0.31 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 30 percent lower than estimates from 2012 ($5.1 million vs. $7.3 million) due to a 30-percent decrease in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 32 percent using 2017 data because the number of beef cows increased by 4 percent in 2017, which amplified the decrease in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Maryland varies over time and is economically important not only from a beef production standpoint ($24.3 million), but also from the provision of ecosystem services ($5.1 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Maryland Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$40.00
General Services (b)	$29.28
Wildlife Value (c)	$88.37
Total Value Per Acre: Private (a+b+c)	$157.65

Ag. Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	32,455	46,129
Total Value Per Acre	$157.65	$157.65
Private Rangeland Value**	$5,116,509	$7,272,205
Beef Production Values		
Total Rangeland Values	$5,116,509	$7,272,205
Number of Beef Cows*	19,764	18,992
Value Per Beef Cow	$258.88	$382.91
Value Per Beef Cow	$258.88	$382.91
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.31	$0.46

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Massachusetts

INTRODUCTION

The 2017 Census of Agriculture classified more than 600 agricultural operations in Massachusetts as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 44,020 acres of private land, including 10,963 acres of pasture/rangeland. This land base represented 1 percent of non-urban land in Massachusetts and supported over 3,000 head of beef cows in 2017. The production from these ranches generated $4.2 million of gross revenue, including $3.0 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $425.4 million. Massachusetts beef cattle ranches also employed nearly 2,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Massachusetts beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation, from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Massachusetts in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 46 percent of the beef cows and 24 percent of the total pasture/rangeland reported in the Census of Agriculture for Massachusetts. The uncertainty regarding how much of the remaining 76 percent of pasture/rangeland is grazed by beef cattle rather than

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

other types of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Massachusetts beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Massachusetts were estimated to be $27.00, $23.71, and $205.58 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $256.30 per acre of private pasture/rangeland. Applying these per acre values to the 10,963 acres of private pasture/rangeland used by beef cattle ranches in Massachusetts resulted in an estimated $2.8 million in total ecosystem services provided annually. This represents an ecosystem services value of $890.30 per beef cow and $1.06 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 5 percent higher than estimates from 2012 ($2.8 million vs. $2.7 million) due to a 5-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 8 percent using 2017 data because the number of beef cows increased by 15 percent in 2017, which more than offset the increase in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Massachusetts varies over time and is economically important not only from a beef production standpoint ($3.0 million), but also from the provision of ecosystem services ($2.8 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Massachusetts Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$27.00
General Services (b)	$23.71
Wildlife Value (c)	$205.58
Total Value Per Acre: Private (a+b+c)	$256.30

Ag. Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	10,963	10,398
Total Value Per Acre	$256.30	$256.30
Private Rangeland Value**	$2,809,777	$2,664,969
Beef Production Values		
Total Rangeland Values	$2,809,777	$2,664,969
Number of Beef Cows*	3,156	2,751
Value Per Beef Cow	$890.30	$968.73
Value Per Beef Cow	$890.30	$968.73
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$1.06	$1.15

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Michigan

INTRODUCTION

The 2017 Census of Agriculture classified nearly 5,600 agricultural operations in Michigan as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 519,488 acres of private land, including 107,768 acres of pasture/rangeland. This land base represented nearly 2 percent of non-metro, non-urban land in Michigan and supported nearly 51,000 head of beef cows in 2017. The production from these ranches generated $235.3 million of gross revenue, including $177.9 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $2.6 billion. Michigan beef cattle ranches also employed close to 19,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Michigan beef cattle ranching -based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Michigan in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 49 percent of the beef cows and 32 percent of the total pasture/rangeland reported in the Census of Agriculture for Michigan. The uncertainty regarding how much of the remaining 68 percent of pasture/rangeland is grazed by beef cattle rather than other

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

types of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Michigan beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Michigan were estimated to be $28.00, $15.44, and $64.50 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $107.94 per acre of private pasture/rangeland. Applying these per acre values to the 107,768 acres of private pasture/rangeland used by beef cattle ranches in Michigan resulted in an estimated $11.6 million in total ecosystem services provided annually. This represents an ecosystem services value of $228.10 per beef cow and $0.27 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 13 percent lower than estimates from 2012 ($11.6 million vs. $13.4 million) due to a 13-percent decrease in private pasture/rangeland acres in 2017; however, The value per beef cow and value per pound of beef decreased by 11 percent using 2017 data because the number of beef cows decreased by only 3 percent in 2017, which partially offset the decrease in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Michigan varies over time and is economically important not only from a beef production standpoint ($177.9 million), but also from the provision of ecosystem services ($11.6 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Michigan Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$28.00
General Services (b)	$15.44
Wildlife Value (c)	$64.50
Total Value Per Acre: Private (a+b+c)	$107.94

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	107,768	124,347
Total Value Per Acre	$107.94	$107.94
Private Rangeland Value**	$11,632,842	$13,422,435
Beef Production Values		
Total Rangeland Values	$11,632,842	$13,422,435
Number of Beef Cows*	50,999	52,529
Value Per Beef Cow	$228.10	$255.52
Value Per Beef Cow	$228.10	$255.52
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.27	$0.30

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Minnesota

INTRODUCTION

The 2017 Census of Agriculture classified more than 8,600 agricultural operations in Minnesota as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 1.4 million acres of private land, including 396,813 acres of pasture/rangeland. This land base represented nearly 4 percent of non-metro, non-urban land in Minnesota and supported over 162,000 head of beef cows in 2017. The production from these ranches generated $659.8 million of gross revenue, including $496.5 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $5.6 billion. Minnesota beef cattle ranches also employed more than 26,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Minnesota beef cattle ranching- based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Minnesota in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported by the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 44 percent of the beef cows and 37 percent of the total pasture/rangeland reported in the Census of Agriculture for Minnesota. The uncertainty regarding how much of the remaining 63 percent of pasture/rangeland is grazed by beef cattle rather than other

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

types of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Minnesota beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Minnesota were estimated to be $30.00, $16.33, and $66.61 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $112.93 per acre of private pasture/rangeland. Applying these per acre values to the 396,813 acres of private pasture/rangeland used by beef cattle ranches in Minnesota resulted in an estimated $44.8 million in total ecosystem services provided annually. This represents an ecosystem services value of $275.88 per beef cow and $0.33 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 10 percent higher than estimates from 2012 ($44.8 million vs. $40.8 million) due to a 10-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 4 percent using 2017 data because the number of beef cows increased by 14 percent in 2017, which more than offset the increase in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Minnesota varies over time and is economically important not only from a beef production standpoint ($496.5 million), but also from the provision of ecosystem services ($44.8 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Minnesota Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$30.00
General Services (b)	$16.33
Wildlife Value (c)	$66.61
Total Value Per Acre: Private (a+b+c)	$112.93

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	396,813	361,306
Total Value Per Acre	$112.93	$112.93
Private Rangeland Value**	$44,814,044	$40,804,063
Beef Production Values		
Total Rangeland Values	$44,814,044	$40,804,063
Number of Beef Cows*	162,443	142,417
Value Per Beef Cow	$275.88	$286.51
Value Per Beef Cow	$275.88	$286.51
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.33	$0.34

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Mississippi

INTRODUCTION

The 2017 Census of Agriculture classified more than 13,200 agricultural operations in Mississippi as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 1.1 million acres of pasture/rangeland. This land base supported over 398,000 head of beef cows in 2017. The production from these ranches generated $381.9 million of gross revenue, including $334.8 million from the sale of cattle and calves. Mississippi beef cattle ranches also employed close to 41,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Mississippi beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation, from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Mississippi in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 79 percent of the beef cows and 67 percent of the total pasture/rangeland reported in the Census of Agriculture for Mississippi. The uncertainty regarding how much of the remaining 33 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

RESULTS

Table 1 summarizes the value of Mississippi beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Mississippi were estimated to be $18.00, $13.92, and $52.32 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $84.24 per acre of private pasture/rangeland. Applying these per acre values to the 1.1 million acres of private pasture/rangeland used by beef cattle ranches in Mississippi resulted in an estimated $89.6 million in total ecosystem services provided annually. This represents an ecosystem services value of $225.03 per beef cow and $0.27 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was slightly higher than estimates from 2012 ($89.631 million vs. $89.569 million) due to a slight increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 4 percent using 2017 data because the number of beef cows increased by 4 percent in 2017, which reduced the estimates on per-head basis. The results indicate beef cattle ranching in Mississippi varies over time and is economically important not only from a beef production standpoint ($334.8 million), but also from the provision of ecosystem services ($89.6 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Mississippi Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$18.00
General Services (b)	$13.92
Wildlife Value (c)	$52.32
Total Value Per Acre: Private (a+b+c)	$84.24

Ag. Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	1,063,999	1,063,259
Total Value Per Acre	$84.24	$84.24
Private Rangeland Value**	$89,631,349	$89,569,011
Beef Production Values		
Total Rangeland Values	$89,631,349	$89,569,011
Number of Beef Cows*	398,316	383,448
Value Per Beef Cow	$225.03	$233.59
Value Per Beef Cow	$225.03	$233.59
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.27	$0.28

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Missouri

INTRODUCTION

The 2017 Census of Agriculture classified more than 41,900 agricultural operations in Missouri as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 10.1 million acres of private land, including 4.9 million acres of pasture/rangeland. This land base represented over 31 percent of non-metro, non-urban land in Missouri and supported over 1.6 million head of beef cows in 2017. The production from these ranches generated $1.6 billion of gross revenue, including $1.3 billion from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $29.5 billion. Missouri beef cattle ranches also employed more than 132,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Missouri beef cattle ranching -based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Missouri in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 74 percent of the beef cows and 71 percent of the total pasture/rangeland reported in the Census of Agriculture for Missouri. The uncertainty regarding how much of the remaining 29 percent of pasture/rangeland is grazed by beef cattle rather than other types

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Missouri beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Missouri were estimated to be $31.00, $20.07, and $52.37 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $103.45 per acre of private pasture/rangeland. Applying these per acre values to the 4.9 million acres of private pasture/rangeland used by beef cattle ranches in Missouri resulted in an estimated $503.7 million in total ecosystem services provided annually. This represents an ecosystem services value of $313.43 per beef cow and $0.37 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 7 percent higher than estimates from 2012 ($503.7 million vs. $472.4 million) due to a 7-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 18 percent using 2017 data because the number of beef cows increased by 30 percent in 2017, which more than offset the increase in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Missouri varies over time and is economically important not only from a beef production standpoint ($1.3 billion), but also from the provision of ecosystem services ($503.7 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Missouri Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$31.00
General Services (b)	$20.07
Wildlife Value (c)	$52.37
Total Value Per Acre: Private (a+b+c)	$103.45

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	4,869,444	4,566,830
Total Value Per Acre	$103.45	$103.45
Private Rangeland Value**	$503,727,356	$472,422,971
Beef Production Values		
Total Rangeland Values	$503,727,356	$472,422,971
Number of Beef Cows*	1,607,145	1,235,315
Value Per Beef Cow	$313.43	$382.43
Value Per Beef Cow	$313.43	$382.43
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.37	$0.45

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Montana

INTRODUCTION

The 2017 Census of Agriculture classified nearly 9,600 agricultural operations in the Montana as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 33.0 million acres of private land, including 27.6 million acres of pasture/rangeland. They also utilized 7.1 million acres of Bureau of Land Management (BLM) land and 4.8 million acres of U.S. Forest Service (USFS) land. Combined, this land base represented almost 52 percent of non-metro, non-urban land in Montana and supported close to 1.3 million head of beef cows in 2017. The production from these ranches generated $1.8 billion of gross revenue, including $1.5 billion from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $28.7 billion. Montana beef cattle ranches also employed more than 38,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Montana beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated and expanded estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data and by including estimates of the ecosystem service value of cattle grazing on federal lands. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). Forage production values for federal rangelands associated with beef cattle ranching were calculated on a per acre basis from monthly per animal unit grazing fee rates for cattle (NASS, 2019). Specific information on the quantity of BLM grazing was obtained from the 2018 Public Land Statistics (BLM, 2019). Specific information on the quantity of USFS grazing was obtained from the FY 2016 Grazing Statistical Summary (USFS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem values of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. The total acres of federal rangeland were obtained through a GIS analysis of federal grazing allotments (Reeves, 2020). All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Montana in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms

(NAICS 112111).[1] These agricultural operations account for 87 percent of the beef cows and 72 percent of the total pasture/rangeland reported in the Census of Agriculture for Montana. The uncertainty regarding how much of the remaining 28 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and the acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Montana beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of federal forage production, private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Montana were estimated to be $3.24, $6.30, $4.91, and $5.74 per acre, respectively. Combining these four values yields an estimated total economic value of ecosystem services for beef cattle ranching of $13.88 per acre of federal rangeland and $16.95 per acre of private pasture/rangeland. Applying these per acre values to the 11.8 million acres of federal rangeland and the 27.6 million acres of private pasture/rangeland used by beef cattle ranches in Montana resulted in an estimated $631.3 million in total ecosystem services provided annually. This represents an ecosystem services value of $489.91 per beef cow and $0.58 per pound of retail beef. Results were also broken down into the relative contribution of these values from federal grazing (26 percent) versus private grazing (74 percent).

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 7 percent higher than estimates from 2012 ($467.0 million vs. $438.2 million) due to a 7-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef declined by 7 percent using 2017 data because the number of beef cows increased by 12 percent in 2017, which more than offset the increase in private pasture/rangeland values on a per-head basis. The results indicate beef cattle ranching in Montana varies over time and is economically important not only from a beef production standpoint ($1.5 billion), but also from the provision of ecosystem services ($631.3 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

Table 1. Value of Montana Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values		
Federal Forage (a)	$3.24	
Private Forage (b)	$6.30	
General Services (c)	$4.91	
Wildlife Value (d)	$5.74	
Total Value Per Acre: Federal (a+c+d)	$13.88	
Total Value Per Acre: Private (b+c+d)	$16.95	
Federal Rangeland Values		
Federal Rangeland (2017 Acres)	11,839,319	
Total Value Per Acre	$13.88	
Federal Rangeland Value (e)	$164,357,912	
Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	27,557,063	25,857,102
Total Value Per Acre	$16.95	$16.95
Private Rangeland Value (f)	$466,984,506	$438,176,812
Total Rangeland Values (e+f)**	**$631,342,418**	**$602,534,724**
% Contribution to Total Rangeland Value		
Federal (g)	26%	27%
Private (h)	74%	73%
Beef Production Values		
Total Rangeland Values (e+f)	$631,342,418	$602,534,724
Number of Beef Cows*	1,288,703	1,146,621
Value Per Beef Cow (i)	$489.91	$525.49
Value Per Beef Cow: Federal (i × g)	$127.54	$143.34
Value Per Beef Cow: Private (i × h)	$362.37	$382.15
Value Per Beef Cow	$489.91	$525.49
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef (j)	$0.58	$0.62
Value Per LB of Beef: Federal (j × g)	$0.15	$0.17
Value Per LB of Beef: Private (j × h)	$0.43	$0.45

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture. Data limitations precluded this same comparison for federal grazing.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Nebraska

INTRODUCTION

The 2017 Census of Agriculture classified nearly 11,600 agricultural operations in the Nebraska as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 16.9 million acres of private land, including 14.0 million acres of pasture/rangeland. They also utilized 332,857 acres of U.S. Forest Service (USFS) land. Combined, this land base represented over 38 percent of non-metro, non-urban land in Nebraska and supported close to 1,143,000 head of beef cows in 2017. The production from these ranches generated $2.4 billion of gross revenue, including $2.0 billion from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $22.9 billion. Nebraska beef cattle ranches also employed more than 39,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Nebraska beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated and expanded estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data and by including estimates of the ecosystem service value of cattle grazing on federal lands. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). Forage production values for federal rangelands associated with beef cattle ranching were calculated on a per acre basis from monthly per animal unit grazing fee rates for cattle (NASS, 2019). Specific information on the quantity of Bureau of Land Management (BLM) grazing was obtained from the 2018 Public Land Statistics (BLM, 2019). Specific information on the quantity of USFS grazing was obtained from the FY 2016 Grazing Statistical Summary (USFS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem values of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. The total acres of federal rangeland were obtained through a GIS analysis of federal grazing allotments (Reeves, 2020). All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Nebraska in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms

(NAICS 112111).[1] These agricultural operations account for 60 percent of the beef cows and 65 percent of the total pasture/rangeland reported in the Census of Agriculture for Nebraska. The uncertainty regarding how much of the remaining 35 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and the acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Nebraska beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of federal forage production, private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Nebraska were estimated to be $12.68, $24.50, $11.86, and $7.01 per acre, respectively. Combining these four values yields an estimated total economic value of ecosystem services for beef cattle ranching of $31.55 per acre of federal rangeland and $43.37 per acre of private pasture/rangeland. Applying these per acre values to the 332,857 acres of federal rangeland and the 14.0 million acres of private pasture/rangeland used by beef cattle ranches in Nebraska resulted in an estimated $615.8 million in total ecosystem services provided annually. This represents an ecosystem services value of $538.94 per beef cow and $0.64 per pound of retail beef. Results were also broken down into the relative contribution of these values from federal grazing (2 percent) versus private grazing (98 percent).

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 3 percent higher than estimates from 2012 ($605.3 million vs. $589.6 million) due to a 3-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef declined by 14 percent using 2017 data because the number of beef cows increased by 20 percent in 2017, which more than offset the increase in private pasture/rangeland values on a per-head basis. The results indicate beef cattle ranching in Nebraska varies over time and is economically important not only from a beef production standpoint ($2.0 billion), but also from the provision of ecosystem services ($615.8 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

Table 1. Value of Nebraska Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values		
Federal Forage (a)	$12.68	
Private Forage (b)	$24.50	
General Services (c)	$11.86	
Wildlife Value (d)	$7.01	
Total Value Per Acre: Federal (a+c+d)	$31.55	
Total Value Per Acre: Private (b+c+d)	$43.37	
Federal Rangeland Values		
Federal Rangeland (2017 Acres)	332,857	
Total Value Per Acre	$31.55	
Federal Rangeland Value (e)	$10,503,095	
Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	13,955,019	13,592,498
Total Value Per Acre	$43.37	$43.37
Private Rangeland Value (f)	$605,297,073	$589,572,773
Total Rangeland Values (e+f)**	**$615,800,168**	**$600,075,868**
% Contribution to Total Rangeland Value		
Federal (g)	2%	2%
Private (h)	98%	98%
Beef Production Values		
Total Rangeland Values (e+f)	$615,800,168	$600,075,868
Number of Beef Cows*	1,142,620	955,813
Value Per Beef Cow (i)	$538.94	$627.82
Value Per Beef Cow: Federal (i × g)	$9.19	$10.99
Value Per Beef Cow: Private (i × h)	$529.74	$616.83
Value Per Beef Cow	$538.94	$627.82
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef (j)	$0.64	$0.75
Value Per LB of Beef: Federal (j × g)	$0.01	$0.01
Value Per LB of Beef: Private (j × h)	$0.63	$0.73

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture. Data limitations precluded this same comparison for federal grazing.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Nevada

INTRODUCTION

The 2017 Census of Agriculture classified more than 1,200 agricultural operations in the Nevada as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 4.0 million acres of private land, including 3.3 million acres of pasture/rangeland. They also utilized 36.1 million acres of Bureau of Land Management (BLM) land and 3.5 million acres of U.S. Forest Service (USFS) land. Combined, this land base represented over 71 percent of non-metro, non-urban land in Nevada and supported more than 205,000 head of beef cows in 2017. The production from these ranches generated $226.2 million of gross revenue, including $205.9 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $2.8 billion. Nevada beef cattle ranches also employed more than 5,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Nevada beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated and expanded estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data and by including estimates of the ecosystem service value of cattle grazing on federal lands. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). Forage production values for federal rangelands associated with beef cattle ranching were calculated on a per acre basis from monthly per animal unit grazing fee rates for cattle (NASS, 2019). Specific information on the quantity of BLM grazing was obtained from the 2018 Public Land Statistics (BLM, 2019). Specific information on the quantity of USFS grazing was obtained from the FY 2016 Grazing Statistical Summary (USFS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem values of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. The total acres of federal rangeland were obtained through a GIS analysis of federal grazing allotments (Reeves, 2020). All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Nevada in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms

(NAICS 112111).[1] These agricultural operations account for 83 percent of the beef cows and 68 percent of the total pasture/rangeland reported in the Census of Agriculture for Nevada. The uncertainty regarding how much of the remaining 32 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and the acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Nevada beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of federal forage production, private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Nevada were estimated to be $0.34, $16.00, $1.96, and $3.74 per acre, respectively. Combining these four values yields an estimated total economic value of ecosystem services for beef cattle ranching of $6.04 per acre of federal rangeland and $21.69 per acre of private pasture/rangeland. Applying these per acre values to the 39.7 million acres of federal rangeland and the 3.3 million acres of private pasture/rangeland used by beef cattle ranches in Nevada resulted in an estimated $310.4 million in total ecosystem services provided annually. This represents an ecosystem services value of $1,511.30 per beef cow and $1.80 per pound of retail beef. Results were also broken down into the relative contribution of these values from federal grazing (77 percent) versus private grazing (23 percent).

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 7 percent higher than estimates from 2012 ($71.1 million vs. $66.2 million) due to a 7-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef declined by 8 percent using 2017 data because the number of beef cows increased by 11 percent in 2017, which more than offset the increase in private pasture/rangeland values on a per-head basis. The results indicate beef cattle ranching in Nevada varies over time and is economically important not only from a beef production standpoint ($205.9 million), but also from the provision of ecosystem services ($310.4 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

Table 1. Value of Nevada Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values		
Federal Forage (a)	$0.34	
Private Forage (b)	$16.00	
General Services (c)	$1.96	
Wildlife Value (d)	$3.74	
Total Value Per Acre: Federal (a+c+d)	$6.04	
Total Value Per Acre: Private (b+c+d)	$21.69	
Federal Rangeland Values		
Federal Rangeland (2017 Acres)	39,647,078	
Total Value Per Acre	$6.04	
Federal Rangeland Value (e)	$239,296,418	
Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	3,278,957	3,050,480
Total Value Per Acre	$21.69	$21.69
Private Rangeland Value (f)	$71,130,925	$66,174,537
Total Rangeland Values (e+f)**	**$310,427,342**	**$305,470,955**
% Contribution to Total Rangeland Value		
Federal (g)	77%	78%
Private (h)	23%	22%
Beef Production Values		
Total Rangeland Values (e+f)	$310,427,342	$305,470,955
Number of Beef Cows*	205,404	185,613
Value Per Beef Cow (i)	$1,511.30	$1,645.74
Value Per Beef Cow: Federal (i × g)	$1,165.00	$1,289.22
Value Per Beef Cow: Private (i × h)	$346.30	$356.52
Value Per Beef Cow	$1,511.30	$1,645.74
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef (j)	$1.80	$1.96
Value Per LB of Beef: Federal (j × g)	$1.39	$1.53
Value Per LB of Beef: Private (j × h)	$0.41	$0.42

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture. Data limitations precluded this same comparison for federal grazing.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – New Hampshire

INTRODUCTION

The 2017 Census of Agriculture classified more than 400 agricultural operations in New Hampshire as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 38,960 acres of private land, including 6,888 acres of pasture/rangeland. This land base represented close to 1 percent of non-metro, non-urban land in New Hampshire and supported more than 2,000 head of beef cows in 2017. The production from these ranches generated $4.0 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $263.3 million. New Hampshire beef cattle ranches also employed nearly 1,500 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of New Hampshire beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation, from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in New Hampshire in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 45 percent of the beef cows and 24 percent of the total pasture/rangeland reported in the Census of Agriculture for New Hampshire. The uncertainty regarding how much of the

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

remaining 76 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of New Hampshire beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in New Hampshire were estimated to be $25.75, $17.62, and $87.51 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $130.89 per acre of private pasture/rangeland. Applying these per acre values to the 6,888 acres of private pasture/rangeland used by beef cattle ranches in New Hampshire resulted in an estimated $901,546 in total ecosystem services provided annually. This represents an ecosystem services value of $427.68 per beef cow and $0.51 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 50 percent higher than estimates from 2012 ($901,546 vs. $601,685) due to a 50-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef increased by only 19 percent using 2017 data because the number of beef cows increased by 27 percent in 2017, which partially offset the decrease in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in New Hampshire varies over time and is economically important not only from a beef production standpoint, but also from the provision of ecosystem services ($901,546). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of New Hampshire Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$25.75
General Services (b)	$17.62
Wildlife Value (c)	$87.51
Total Value Per Acre: Private (a+b+c)	$130.89

Ag. Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	6,888	4,597
Total Value Per Acre	$130.89	$130.89
Private Rangeland Value**	$901,546	$601,685
Beef Production Values		
Total Rangeland Values	$901,546	$601,685
Number of Beef Cows*	2,108	1,667
Value Per Beef Cow	$427.68	$360.94
Value Per Beef Cow	$427.68	$360.94
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.51	$0.43

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – New Jersey

INTRODUCTION

The 2017 Census of Agriculture classified more than 700 agricultural operations in New Jersey as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 31,575 acres of private land, including 9,131 acres of pasture/rangeland. This land base represented 1 percent of non-urban land in New Jersey and supported over 4,000 head of beef cows in 2017. The production from these ranches generated $6.5 million of gross revenue, including $4.5 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $479.0 million. New Jersey beef cattle ranches also employed more than 2,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of New Jersey beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in New Jersey in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 46 percent of the beef cows and 15 percent of the total pasture/rangeland reported in the Census of Agriculture for New Jersey. The uncertainty regarding how much of the remaining 85 percent of pasture/rangeland is grazed by beef cattle rather than other

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

types of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of New Jersey beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in New Jersey were estimated to be $36.00, $27.01, and $176.13 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $239.14 per acre of private pasture/rangeland. Applying these per acre values to the 9,131 acres of private pasture/rangeland used by beef cattle ranches in New Jersey resulted in an estimated $2.2 million in total ecosystem services provided annually. This represents an ecosystem services value of $508.05 per beef cow and $0.60 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 2 percent lower than estimates from 2012 ($2.183 million vs. $2.226 million) due to a 2-percent decrease in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 8 percent using 2017 data because the number of beef cows increased by 7 percent in 2017, which amplified the decrease in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in New Jersey varies over time and is economically important not only from a beef production standpoint ($4.5 million), but also from the provision of ecosystem services ($2.2 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of New Jersey Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$36.00
General Services (b)	$27.01
Wildlife Value (c)	$176.13
Total Value Per Acre: Private (a+b+c)	$239.14

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	9,131	9,312
Total Value Per Acre	$239.14	$239.14
Private Rangeland Value**	$2,183,602	$2,226,886
Beef Production Values		
Total Rangeland Values	$2,183,602	$2,226,886
Number of Beef Cows*	4,298	4,033
Value Per Beef Cow	$508.05	$552.17
Value Per Beef Cow	$508.05	$552.17
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.60	$0.66

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – New Mexico

INTRODUCTION

The 2017 Census of Agriculture classified more than 9,500 agricultural operations in the New Mexico as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 29.9 million acres of private land, including 28.1 million acres of pasture/rangeland. They also utilized 12.0 million acres of Bureau of Land Management (BLM) land and 7.4 million acres of U.S. Forest Service (USFS) land. Combined, this land base represented 77 percent of non-metro, non-urban land in New Mexico and supported over 449,000 head of beef cows in 2017. The production from these ranches generated $554.1 million of gross revenue, including $488.0 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $12.2 billion. New Mexico beef cattle ranches also employed more than 34,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of New Mexico beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated and expanded estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data and by including estimates of the ecosystem service value of cattle grazing on federal lands. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). Forage production values for federal rangelands associated with beef cattle ranching were calculated on a per acre basis from monthly per animal unit grazing fee rates for cattle (NASS, 2019). Specific information on the quantity of BLM grazing was obtained from the 2018 Public Land Statistics (BLM, 2019). Specific information on the quantity of USFS grazing was obtained from the FY 2016 Grazing Statistical Summary (USFS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem values of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. The total acres of federal rangeland were obtained through a GIS analysis of federal grazing allotments (Matt Reeves, 2020). All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in New Mexico in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms

(NAICS 112111).[1] These agricultural operations account for 93 percent of the beef cows and 78 percent of the total pasture/rangeland reported in the Census of Agriculture for New Mexico. The uncertainty regarding how much of the remaining 22 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and the acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of New Mexico beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of federal forage production, private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in New Mexico were estimated to be $1.67, $3.20, $2.20, and $6.98 per acre, respectively. Combining these four values yields an estimated total economic value of ecosystem services for beef cattle ranching of $10.84 per acre of federal rangeland and $12.37 per acre of private pasture/rangeland. Applying these per acre values to the 19.4 million acres of federal rangeland and the 28.1 million acres of private pasture/rangeland used by beef cattle ranches in New Mexico resulted in an estimated $557.9 million in total ecosystem services provided annually. This represents an ecosystem services value of $1,242.42 per beef cow and $1.48 per pound of retail beef. Results were also broken down into the relative contribution of these values from federal grazing (38 percent) versus private grazing (62 percent).

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 4 percent higher than estimates from 2012 ($347.2 million vs. $334.6 million) due to a 4-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef declined by 8 percent using 2017 data because the number of beef cows increased by 11 percent in 2017, which partially offset the increase in private pasture/rangeland values on a per-head basis. The results indicate beef cattle ranching in New Mexico varies over time and is economically important not only from a beef production standpoint ($488.0 million), but also from the provision of ecosystem services ($557.9 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

Table 1. Value of New Mexico Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values		
Federal Forage (a)	$1.67	
Private Forage (b)	$3.20	
General Services (c)	$2.20	
Wildlife Value (d)	$6.98	
Total Value Per Acre: Federal (a+c+d)	$10.84	
Total Value Per Acre: Private (b+c+d)	$12.37	
Federal Rangeland Values		
Federal Rangeland (2017 Acres)	19,442,343	
Total Value Per Acre	$10.84	
Federal Rangeland Value (e)	$210,782,578	
Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	28,054,213	27,038,643
Total Value Per Acre	$12.37	$12.37
Private Rangeland Value (f)	$347,161,590	$334,594,248
Total Rangeland Values (e+f)**	**$557,944,168**	**$545,376,826**
% Contribution to Total Rangeland Value		
Federal (g)	38%	39%
Private (h)	62%	61%
Beef Production Values		
Total Rangeland Values (e+f)	$557,944,168	$545,376,826
Number of Beef Cows*	449,080	403,008
Value Per Beef Cow (i)	$1,242.42	$1,353.27
Value Per Beef Cow: Federal (i × g)	$469.37	$523.02
Value Per Beef Cow: Private (i × h)	$773.05	$830.24
Value Per Beef Cow	$1,242.42	$1,353.27
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef (j)	$1.48	$1.61
Value Per LB of Beef: Federal (j × g)	$0.56	$0.62
Value Per LB of Beef: Private (j × h)	$0.92	$0.99

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture. Data limitations precluded this same comparison for federal grazing.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – New York

INTRODUCTION

The 2017 Census of Agriculture classified more than 4,600 agricultural operations in New York as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 658,369 acres of private land, including 128,376 acres of pasture/rangeland. This land base represented 2.4 percent of non-urban land in New York and supported more than 49,000 head of beef cows in 2017. The production from these ranches generated $179.8 million of gross revenue, including $137.4 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $2.2 billion. New York beef cattle ranches also employed more than 15,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of New York beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation, from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in New York in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 45 percent of the beef cows and 22 percent of the total pasture/rangeland reported in the Census of Agriculture for New York. The uncertainty regarding how much of the remaining 78 percent of pasture/rangeland is grazed by beef cattle rather than other

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

types of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of New York beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in New York were estimated to be $23.00, $16.82, and $165.88 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $205.70 per acre of private pasture/rangeland. Applying these per acre values to the 128,376 acres of private pasture/rangeland used by beef cattle ranches in New York result in an estimated $26.4 million in total ecosystem services provided annually. This represents an ecosystem services value of $536.96 per beef cow and $0.64 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 6 percent lower than estimates from 2012 ($26.4 million vs. $28.0 million) due to a 6-percent decrease in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 18 percent using 2017 data because the number of beef cows increased by 15 percent in 2017, which amplified the decrease in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in New York varies over time and is economically important not only from a beef production standpoint ($137.4 million), but also from the provision of ecosystem services ($26.4 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of New York Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$23.00
General Services (b)	$16.82
Wildlife Value (c)	$165.88
Total Value Per Acre: Private (a+b+c)	$205.70

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	128,376	136,185
Total Value Per Acre	$205.70	$205.70
Private Rangeland Value**	$26,406,516	$28,012,801
Beef Production Values		
Total Rangeland Values	$26,406,516	$28,012,801
Number of Beef Cows*	49,178	42,769
Value Per Beef Cow	$536.96	$654.98
Value Per Beef Cow	$536.96	$654.98
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.64	$0.78

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – North Carolina

INTRODUCTION

The 2017 Census of Agriculture classified nearly 13,600 agricultural operations in North Carolina as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 1.4 million acres of private land, including 547,471 acres of pasture/rangeland. This land base represented 4.5 percent of non-urban land in North Carolina and supported more than 242,000 head of beef cows in 2017. The production from these ranches generated $214.5 million of gross revenue, including $189.1 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $7.9 billion. North Carolina beef cattle ranches also employed more than 39,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of North Carolina beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in North Carolina in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 66 percent of the beef cows and 58 percent of the total pasture/rangeland reported in the Census of Agriculture for North Carolina. The uncertainty regarding how much of the remaining 42 percent of pasture/rangeland is grazed by beef cattle

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

rather than other types of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of North Carolina beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in North Carolina were estimated to be $26.00, $23.15, and $72.11 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $121.27 per acre of private pasture/rangeland. Applying these per acre values to the 547,471 acres of private pasture/rangeland used by beef cattle ranches in North Carolina resulted in an estimated $66.4 million in total ecosystem services provided annually. This represents an ecosystem services value of $273.99 per beef cow and $0.33 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 1 percent lower than estimates from 2012 ($66.4 million vs. $67.2 million) due to a 1-percent decrease in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 12 percent using 2017 data because the number of beef cows increased by 13 percent in 2017, which amplified the decrease in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in North Carolina varies over time and is economically important not only from a beef production standpoint ($189.1 million), but also from the provision of ecosystem services ($66.4 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of North Carolina Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$26.00
General Services (b)	$23.15
Wildlife Value (c)	$72.11
Total Value Per Acre: Private (a+b+c)	$121.27

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	547,471	554,431
Total Value Per Acre	$121.27	$121.27
Private Rangeland Value**	$66,391,533	$67,235,569
Beef Production Values		
Total Rangeland Values	$66,391,533	$67,235,569
Number of Beef Cows*	242,313	214,957
Value Per Beef Cow	$273.99	$312.79
Value Per Beef Cow	$273.99	$312.79
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.33	$0.37

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – North Dakota

INTRODUCTION

The 2017 Census of Agriculture classified nearly 5,700 agricultural operations in the North Dakota as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 9.2 million acres of private land, including 5.8 million acres of pasture/rangeland. They also utilized 48,990 acres of Bureau of Land Management (BLM) land and 1.1 million acres of U.S. Forest Service (USFS) land. Combined, this land base represented 26 percent of non-metro, non-urban land in North Dakota and supported more than 641,000 head of beef cows in 2017. The production from these ranches generated $1.0 billion of gross revenue, including $819.2 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $11.1 billion. North Dakota beef cattle ranches also employed close to 18,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of North Dakota beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated and expanded estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data and by including estimates of the ecosystem service value of cattle grazing on federal lands. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). Forage production values for federal rangelands associated with beef cattle ranching were calculated on a per acre basis from monthly per animal unit grazing fee rates for cattle (NASS, 2019). Specific information on the quantity of BLM grazing was obtained from the 2018 Public Land Statistics (BLM, 2019). Specific information on the quantity of USFS grazing was obtained from the FY 2016 Grazing Statistical Summary (USFS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem values of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. The total acres of federal rangeland were obtained through a GIS analysis of federal grazing allotments (Reeves, 2020). All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in North Dakota in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres

and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 65 percent of the beef cows and 58 percent of the total pasture/rangeland reported in the Census of Agriculture for North Dakota. The uncertainty regarding how much of the remaining 42 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and the acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of North Dakota beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of federal forage production, private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in North Dakota were estimated to be $9.44, $17.00, $10.45, and $4.47 per acre, respectively. Combining these four values yields an estimated total economic value of ecosystem services for beef cattle ranching of $24.36 per acre of federal rangeland and $31.92 per acre of private pasture/rangeland. Applying these per acre values to the 1.1 million acres of federal rangeland and the 5.8 million acres of private pasture/rangeland used by beef cattle ranches in North Dakota resulted in an estimated $210.5 million in total ecosystem services provided annually. This represents an ecosystem services value of $328.30 per beef cow and $0.39 per pound of retail beef. Results were also broken down into the relative contribution of these values from federal grazing (13 percent) versus private grazing (87 percent).

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 36 percent higher than estimates from 2012 ($183.6 million vs. $135.1 million) due to a 36-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef declined by 13 percent using 2017 data because the number of beef cows increased by 49 percent in 2017, which more than offset the increase in private pasture/rangeland values on a per-head basis. The results indicate beef cattle ranching in North Dakota varies over time and is economically important not only from a beef production standpoint ($819.2 million), but also from the provision of ecosystem services ($210.5 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

Table 1. Value of North Dakota Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values		
Federal Forage (a)	$9.44	
Private Forage (b)	$17.00	
General Services (c)	$10.45	
Wildlife Value (d)	$4.47	
Total Value Per Acre: Federal (a+c+d)	$24.36	
Total Value Per Acre : Private (b+c+d)	$31.92	
Federal Rangeland Values		
Federal Rangeland (2017 Acres)	1,101,410	
Total Value Per Acre	$24.36	
Federal Rangeland Value (e)	$26,826,916	
Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	5,753,602	4,234,308
Total Value Per Acre	$31.92	$31.92
Private Rangeland Value (f)	$183,634,276	$135,143,878
Total Rangeland Values (e+f)**	**$210,461,192**	**$161,970,793**
% Contribution to Total Rangeland Value		
Federal (g)	13%	17%
Private (h)	87%	83%
Beef Production Values		
Total Rangeland Values (e+f)	$210,461,192	$161,970,793
Number of Beef Cows*	641,062	429,760
Value Per Beef Cow (i)	$328.30	$376.89
Value Per Beef Cow: Federal (i × g)	$41.85	$62.42
Value Per Beef Cow: Private (i × h)	$286.45	$314.46
Value Per Beef Cow	$328.30	$376.89
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef (j)	$0.39	$0.45
Value Per LB of Beef: Federal (j × g)	$0.05	$0.07
Value Per LB of Beef: Private (j × h)	$0.34	$0.37

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture. Data limitations precluded this same comparison for federal grazing.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Ohio

INTRODUCTION

The 2017 Census of Agriculture classified nearly 13,000 agricultural operations in Ohio as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 1.2 million acres of private land, including 384,140 acres of pasture/rangeland. This land base represented 5 percent of the non-urban land in Ohio and supported nearly 158,000 head of beef cows in 2017. The production from these ranches generated $322.6 million of gross revenue, including $259.7 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $6.4 billion. Ohio beef cattle ranches also employed close to 44,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Ohio beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Ohio in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 52 percent of the beef cows and 42 percent of the total pasture/rangeland reported in the Census of Agriculture for Ohio. The uncertainty regarding how much of the remaining 58 percent of pasture/rangeland is grazed by beef cattle rather than other types

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Ohio beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Ohio were estimated to be $25.00, $19.55, and $92.43 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $136.98 per acre of private pasture/rangeland. Applying these per acre values to the 384,140 acres of private pasture/rangeland used by beef cattle ranches in Ohio resulted in an estimated $54.9 million in total ecosystem services provided annually. This represents an ecosystem services value of $347.95 per beef cow and $0.41 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 4 percent higher than estimates from 2012 ($54.9 million vs. $52.6 million) due to a 4-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 6 percent using 2017 data because the number of beef cows increased by 12 percent in 2017, which more than offset the increase in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Ohio varies over time and is economically important not only from a beef production standpoint ($259.7 million), but also from the provision of ecosystem services ($54.9 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Ohio Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$25.00
General Services (b)	$19.55
Wildlife Value (c)	$92.43
Total Value Per Acre: Private (a+b+c)	$136.98

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	400,848	384,140
Total Value Per Acre	$136.98	$136.98
Private Rangeland Value**	$54,908,206	$52,619,542
Beef Production Values		
Total Rangeland Values	$54,908,206	$52,619,542
Number of Beef Cows*	157,804	141,590
Value Per Beef Cow	$347.95	$371.63
Value Per Beef Cow	$347.95	$371.63
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.41	$0.44

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Oklahoma

INTRODUCTION

The 2017 Census of Agriculture classified more than 45,600 agricultural operations in the Oklahoma as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 22.8 million acres of private land, including 15.6 million acres of pasture/rangeland. They also utilized 43,837 acres of U.S. Forest Service (USFS) land. Combined, this land base represented nearly 66 percent of non-metro, non-urban land in Oklahoma and supported more than 1.8 million head of beef cows in 2017. The production from these ranches generated $2.8 billion of gross revenue, including $2.5 billion from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $42.1 billion. Oklahoma beef cattle ranches also employed more than 148,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Oklahoma beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated and expanded estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data and by including estimates of the ecosystem service value of cattle grazing on federal lands. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). Forage production values for federal rangelands associated with beef cattle ranching were calculated on a per acre basis from monthly per animal unit grazing fee rates for cattle (NASS, 2019). Specific information on the quantity of Bureau of Land Management (BLM) grazing was obtained from the 2018 Public Land Statistics (BLM, 2019). Specific information on the quantity of USFS grazing was obtained from the FY 2016 Grazing Statistical Summary (USFS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem values of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. The total acres of federal rangeland were obtained through a GIS analysis of federal grazing allotments (Reeves, 2020). All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Oklahoma in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms

(NAICS 112111).[1] These agricultural operations account for 87 percent of the beef cows and 81 percent of the total pasture/rangeland reported in the Census of Agriculture for Oklahoma. The uncertainty regarding how much of the remaining 19 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and the acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Oklahoma beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of federal forage production, private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Oklahoma were estimated to be $4.03, $13.00, $9.75, and $23.51 per acre, respectively. Combining these four values yields an estimated total economic value of ecosystem services for beef cattle ranching of $37.29 per acre of federal rangeland and $46.26 per acre of private pasture/rangeland. Applying these per acre values to the 43,837 acres of federal rangeland and the 15.6 million acres of private pasture/rangeland used by beef cattle ranches in Oklahoma resulted in an estimated $722.4 million in total ecosystem services provided annually. This represents an ecosystem services value of $389.19 per beef cow and $0.46 per pound of retail beef. Results were also broken down into the relative contribution of these values from federal grazing (less than 1 percent) versus private grazing (nearly 100 percent).

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 19 percent higher than estimates from 2012 ($720.8 million vs. $606.3 million) due to a 19-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef declined by 15 percent using 2017 data because the number of beef cows increased by 40 percent in 2017, which more than offset the increase in private pasture/rangeland values on a per-head basis. The results indicate beef cattle ranching in Oklahoma varies over time and is economically important not only from a beef production standpoint ($2.5 billion), but also from the provision of ecosystem services ($722.4 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

Table 1. Value of Oklahoma Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values		
Federal Forage (a)	$4.03	
Private Forage (b)	$13.00	
General Services (c)	$9.75	
Wildlife Value (d)	$23.51	
Total Value Per Acre: Federal (a+c+d)	$37.29	
Total Value Per Acre: Private (b+c+d)	$46.26	
Federal Rangeland Values		
Federal Rangeland (2017 Acres)	43,837	
Total Value Per Acre	$37.29	
Federal Rangeland Value (e)	$1,634,520	
Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	15,581,489	13,106,864
Total Value Per Acre	$46.26	$46.26
Private Rangeland Value (f)	$720,776,359	$606,303,911
Total Rangeland Values (e+f)**	**$722,410,879**	**$607,938,430**
% Contribution to Total Rangeland Value		
Federal (g)	0%	0%
Private (h)	100%	100%
Beef Production Values		
Total Rangeland Values (e+f)	$722,410,879	$607,938,430
Number of Beef Cows*	1,856,212	1,324,911
Value Per Beef Cow (i)	$389.19	$458.85
Value Per Beef Cow: Federal (i x g)	$0.88	$1.23
Value Per Beef Cow: Private (i x h)	$388.30	$457.62
Value Per Beef Cow	$389.19	$458.85
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef (j)	$0.46	$0.55
Value Per LB of Beef: Federal (j x g)	$0.00	$0.00
Value Per LB of Beef: Private (j x h)	$0.46	$0.54

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture. Data limitations precluded this same comparison for federal grazing.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Oregon

INTRODUCTION

The 2017 Census of Agriculture classified nearly 11,900 agricultural operations in the Oregon as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 8.0 million acres of private land, including 6.1 million acres of pasture/rangeland. They also utilized 12.4 million acres of Bureau of Land Management (BLM) land and 6.0 million acres of U.S. Forest Service (USFS) land. Combined, this land base represented close to 55 percent of non-metro, non-urban land in Oregon and supported more than 461,000 head of beef cows in 2017. The production from these ranches generated $630.9 million of gross revenue, including $558.6 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $13.0 billion. Oregon beef cattle ranches also employed nearly 45,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Oregon beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated and expanded estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data and by including estimates of the ecosystem service value of cattle grazing on federal lands. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). Forage production values for federal rangelands associated with beef cattle ranching were calculated on a per acre basis from monthly per animal unit grazing fee rates for cattle (NASS, 2019). Specific information on the quantity of BLM grazing was obtained from the 2018 Public Land Statistics (BLM, 2019). Specific information on the quantity of USFS grazing was obtained from the FY 2016 Grazing Statistical Summary (USFS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem values of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. The total acres of federal rangeland were obtained through a GIS analysis of federal grazing allotments (Reeves, 2020). All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Oregon in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms

(NAICS 112111).[1] These agricultural operations account for 86 percent of the beef cows and 67 percent of the total pasture/rangeland reported in the Census of Agriculture for Oregon. The uncertainty regarding how much of the remaining 33 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and the acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Oregon beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of federal forage production, private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Oregon were estimated to be $1.05, $11.00, $9.29, and $20.87 per acre, respectively. Combining these four values yields an estimated total economic value of ecosystem services for beef cattle ranching of $31.20 per acre of federal rangeland and $41.16 per acre of private pasture/rangeland. Applying these per acre values to the 18.5 million acres of federal rangeland and the 6.1 million acres of private pasture/rangeland used by beef cattle ranches in Oregon resulted in an estimated $826.6 million in total ecosystem services provided annually. This represents an ecosystem services value of $1,792.75 per beef cow and $2.13 per pound of retail beef. Results were also broken down into the relative contribution of these values from federal grazing (70 percent) versus private grazing (30 percent).

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 1 percent lower than estimates from 2012 ($250.8 million vs. $254.4 million) due to a 1-percent decrease in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef declined by 10 percent using 2017 data because the number of beef cows increased by 10 percent in 2017, which amplified the decrease in private pasture/rangeland values on a per-head basis. The results indicate beef cattle ranching in Oregon varies over time and is economically important not only from a beef production standpoint ($558.6 million), but also from the provision of ecosystem services ($826.6 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

Table 1. Value of Oregon Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values		
Federal Forage (a)	$1.05	
Private Forage (b)	$11.00	
General Services (c)	$9.29	
Wildlife Value (d)	$20.87	
Total Value Per Acre: Federal (a+c+d)	$31.20	
Total Value Per Acre: Private (b+c+d)	$41.16	
Federal Rangeland Values		
Federal Rangeland (2017 Acres)	18,454,135	
Total Value Per Acre	$31.20	
Federal Rangeland Value (e)	$575,828,945	
Ag. Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	6,092,393	6,180,019
Total Value Per Acre	$41.16	$41.16
Private Rangeland Value (f)	$250,751,495	$254,358,017
Total Rangeland Values (e+f)**	**$826,580,440**	**$830,186,962**
% Contribution to Total Rangeland Value		
Federal (g)	70%	69%
Private (h)	30%	31%
Beef Production Values		
Total Rangeland Values (e+f)	$826,580,440	$830,186,962
Number of Beef Cows*	461,068	418,123
Value Per Beef Cow (i)	$1,792.75	$1,985.51
Value Per Beef Cow: Federal (i × g)	$1,248.90	$1,377.18
Value Per Beef Cow: Private (i × h)	$543.85	$608.33
Value Per Beef Cow	$1,792.75	$1,985.51
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef (j)	$2.13	$2.36
Value Per LB of Beef: Federal (j × g)	$1.49	$1.64
Value Per LB of Beef: Private (j × h)	$0.65	$0.72

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture. Data limitations precluded this same comparison for federal grazing.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Pennsylvania

INTRODUCTION

The 2017 Census of Agriculture classified more than 7,100 agricultural operations in Pennsylvania as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 754,240 acres of private land, including 184,798 acres of pasture/rangeland. This land base represented nearly 3 percent of non-urban land in Pennsylvania and supported more than 86,000 head of beef cows in 2017. The production from these ranches generated $242.4 million of gross revenue, including $189.1 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $4.8 billion. Pennsylvania beef cattle ranches also employed more than 25,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Pennsylvania beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation, from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Pennsylvania in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 40 percent of the beef cows and 26 percent of the total pasture/rangeland reported in the Census of Agriculture for Pennsylvania. The uncertainty regarding how much of the remaining 74 percent of pasture/rangeland is grazed by beef cattle rather than other

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

types of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Pennsylvania beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Pennsylvania were estimated to be $44.00, $31.90, and $53.96 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $129.85 per acre of private pasture/rangeland. Applying these per acre values to the 184,798 acres of private pasture/rangeland used by beef cattle ranches in Pennsylvania result in an estimated $24.0 million in total ecosystem services provided annually. This represents an ecosystem services value of $277.58 per beef cow and $0.33 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 2 percent higher than estimates from 2012 ($24.0 million vs. $23.6 million) due to a 2-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 29 percent using 2017 data because the number of beef cows increased by 42 percent in 2017, which more than offset the increase in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Pennsylvania varies over time and is economically important not only from a beef production standpoint ($189.1 million), but also from the provision of ecosystem services ($24.0 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Pennsylvania Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$44.00
General Services (b)	$31.90
Wildlife Value (c)	$53.96
Total Value Per Acre: Private (a+b+c)	$129.85

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	184,798	182,023
Total Value Per Acre	$129.85	$129.85
Private Rangeland Value**	$23,996,837	$23,636,491
Beef Production Values		
Total Rangeland Values	$23,996,837	$23,636,491
Number of Beef Cows*	86,450	60,783
Value Per Beef Cow	$277.58	$388.87
Value Per Beef Cow	$277.58	$388.87
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.33	$0.46

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Rhode Island

INTRODUCTION

The 2017 Census of Agriculture classified more than 100 agricultural operations in Rhode Island as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 2,417 acres of pasture/rangeland. This land base supported over 500 head of beef cows in 2017. The production from these ranches generated $712,000 of gross revenue, including $548,000 from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $113.2 million. Rhode Island beef cattle ranches also employed nearly 400 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Rhode Island beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Rhode Island in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 30 percent of the beef cows and 41 percent of the total pasture/rangeland reported in the Census of Agriculture for Rhode Island. The uncertainty regarding how much of the remaining 59 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

RESULTS

Table 1 summarizes the value of Rhode Island beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Rhode Island were estimated to be $25.75, $19.58, and $169.63 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $214.96 per acre of private pasture/rangeland. Applying these per acre values to the 2,417 acres of private pasture/rangeland used by beef cattle ranches in Rhode Island resulted in an estimated $519,548 in total ecosystem services provided annually. This represents an ecosystem services value of $1,031.20 per beef cow and $1.23 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 56 percent higher than estimates from 2012 ($519,548 vs. $332,751) due to a 56-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef increased by only 29 percent using 2017 data because the number of beef cows increased by 21 percent in 2017, which partially offset the increase in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Rhode Island varies over time and is economically important not only from a beef production standpoint ($548,000), but also from the provision of ecosystem services ($519,548). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Rhode Island Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$25.75
General Services (b)	$19.58
Wildlife Value (c)	$169.63
Total Value Per Acre: Private (a+b+c)	$214.96

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	2,417	1,548
Total Value Per Acre	$214.96	$214.96
Private Rangeland Value**	$519,548	$332,751
Beef Production Values		
Total Rangeland Values	$519,548	$332,751
Number of Beef Cows*	504	415
Value Per Beef Cow	$1,031.20	$801.81
Value Per Beef Cow	$1,031.20	$801.81
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$1.23	$0.95

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – South Carolina

INTRODUCTION

The 2017 Census of Agriculture classified nearly 6,100 agricultural operations in South Carolina as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 871,352 acres of private land, including 331,163 acres of pasture/rangeland. This land base represented 4.5 percent non-urban land in South Carolina and supported close to 130,000 head of beef cows in 2017. The production from these ranches generated $99.7 million of gross revenue, including $84.4 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $3.8 billion. South Carolina beef cattle ranches also employed more than 18,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of South Carolina beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in South Carolina in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 73 percent of the beef cows and 58 percent of the total pasture/rangeland reported in the Census of Agriculture for South Carolina. The uncertainty regarding how much of the remaining 42 percent of pasture/rangeland is grazed by beef cattle

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

rather than other types of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of South Carolina beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in South Carolina were estimated to be $19.00, $16.10, and $33.27 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $68.37 per acre of private pasture/rangeland. Applying these per acre values to the 331,163 acres of private pasture/rangeland used by beef cattle ranches in South Carolina resulted in an estimated $22.6 million in total ecosystem services provided annually. This represents an ecosystem services value of $174.42 per beef cow and $0.21 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 2 percent higher than estimates from 2012 ($22.6 million vs. $22.2 million) due to a 2-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 10 percent using 2017 data because the number of beef cows decreased by 14 percent in 2017, which more than offset the increase in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in South Carolina varies over time and is economically important not only from a beef production standpoint ($84.4 million), but also from the provision of ecosystem services ($22.6 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of South Carolina Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$19.00
General Services (b)	$16.10
Wildlife Value (c)	$33.27
Total Value Per Acre: Private (a+b+c)	$68.37

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	331,163	324,418
Total Value Per Acre	$68.37	$68.37
Private Rangeland Value**	$22,642,992	$22,181,809
Beef Production Values		
Total Rangeland Values	$22,642,992	$22,181,809
Number of Beef Cows*	129,817	114,101
Value Per Beef Cow	$174.42	$194.41
Value Per Beef Cow	$174.42	$194.41
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.21	$0.23

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – South Dakota

INTRODUCTION

The 2017 Census of Agriculture classified nearly 8,800 agricultural operations in the South Dakota as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 18.8 million acres of private land, including 14.6 million acres of pasture/rangeland. They also utilized 213,726 acres of Bureau of Land Management (BLM) land and 1.8 million acres of U.S. Forest Service (USFS) land. Combined, this land base represented 49 percent of non-metro, non-urban land in South Dakota and supported close to 1,209,000 head of beef cows in 2017. The production from these ranches generated $2.2 billion of gross revenue, including $1.7 billion from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $24.2 billion. South Dakota beef cattle ranches also employed more than 31,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of South Dakota beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated and expanded estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data and by including estimates of the ecosystem service value of cattle grazing on federal lands. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). Forage production values for federal rangelands associated with beef cattle ranching were calculated on a per acre basis from monthly per animal unit grazing fee rates for cattle (NASS, 2019). Specific information on the quantity of BLM grazing was obtained from the 2018 Public Land Statistics (BLM, 2019). Specific information on the quantity of USFS grazing was obtained from the FY 2016 Grazing Statistical Summary (USFS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem values of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. The total acres of federal rangeland were obtained through a GIS analysis of federal grazing allotments (Reeves, 2020). All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in South Dakota in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms

(NAICS 112111).[1] These agricultural operations account for 67 percent of the beef cows and 66 percent of the total pasture/rangeland reported in the Census of Agriculture for South Dakota. The uncertainty regarding how much of the remaining 34 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and the acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of South Dakota beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of federal forage production, private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in South Dakota were estimated to be $7.43, $25.00, $9.15, and $11.75 per acre, respectively. Combining these four values yields an estimated total economic value of ecosystem services for beef cattle ranching of $28.33 per acre of federal rangeland and $45.90 per acre of private pasture/rangeland. Applying these per acre values to the 2.0 million acres of federal rangeland and the 14.6 million acres of private pasture/rangeland used by beef cattle ranches in South Dakota resulted in an estimated $725.1 million in total ecosystem services provided annually. This represents an ecosystem services value of $599.87 per beef cow and $0.71 per pound of retail beef. Results were also broken down into the relative contribution of these values from federal grazing (8 percent) versus private grazing (92 percent).

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 12 percent higher than estimates from 2012 ($668.2 million vs. $597.5 million) due to a 12-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef declined by 15 percent using 2017 data because the number of beef cows increased by 30 percent in 2017, which more than offset the increase in private pasture/rangeland values on a per-head basis. The results indicate beef cattle ranching in South Dakota varies over time and is economically important not only from a beef production standpoint ($1.7 billion), but also from the provision of ecosystem services ($725.1 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

Table 1. Value of South Dakota Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values		
Federal Forage (a)	$7.43	
Private Forage (b)	$25.00	
General Services (c)	$9.15	
Wildlife Value (d)	$11.75	
Total Value Per Acre: Federal (a+c+d)	$28.33	
Total Value Per Acre: Private (b+c+d)	$45.90	
Federal Rangeland Values		
Federal Rangeland (2017 Acres)	2,009,043	
Total Value Per Acre	$28.33	
Federal Rangeland Value (e)	$56,907,956	
Ag. Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	14,556,475	13,016,616
Total Value Per Acre	$45.90	$45.90
Private Rangeland Value (f)	$668,152,443	$597,471,831
Total Rangeland Values (e+f)**	**$725,060,399**	**$654,379,788**
% Contribution to Total Rangeland Value		
Federal (g)	8%	9%
Private (h)	92%	91%
Beef Production Values		
Total Rangeland Values (e+f)	$725,060,399	$654,379,788
Number of Beef Cows*	1,208,687	930,191
Value Per Beef Cow (i)	$599.87	$703.49
Value Per Beef Cow: Federal (i × g)	$47.08	$61.18
Value Per Beef Cow: Private (i × h)	$552.79	$642.31
Value Per Beef Cow	$599.87	$703.49
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef (j)	$0.71	$0.84
Value Per LB of Beef: Federal (j × g)	$0.06	$0.07
Value Per LB of Beef: Private (j × h)	$0.66	$0.76

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture. Data limitations precluded this same comparison for federal grazing.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Tennessee

INTRODUCTION

The 2017 Census of Agriculture classified nearly 31,600 agricultural operations in Tennessee as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 4.5 million acres of private land, including 1.9 million acres of pasture/rangeland. This land base represented close to 30 percent of non-metro, non-urban land in Tennessee and supported nearly 752,000 head of beef cows in 2017. The production from these ranches generated $727.0 million of gross revenue, including $618.2 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $19.2 billion. Tennessee beef cattle ranches also employed close to 98,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Tennessee beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Tennessee in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of privately owned pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 83 percent of the beef cows and 74 percent of the total pasture/rangeland reported in the Census of Agriculture for Tennessee. The uncertainty regarding how much of the remaining 26 percent of pasture/rangeland is grazed by beef cattle rather than

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

other types of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Tennessee beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Tennessee were estimated to be $20.00, $15.97, and $117.31 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $153.28 per acre of private pasture/rangeland. Applying these per acre values to the 1.9 million acres of private pasture/rangeland used by beef cattle ranches in Tennessee resulted in an estimated $297.5 million in total ecosystem services provided annually. This represents an ecosystem services value of $395.80 per beef cow and $0.47 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 11 percent lower than estimates from 2012 ($297.5 million vs. $332.4 million) due to an 11-percent decrease in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 10 percent using 2017 data because the number of beef cows decreased by 1 percent in 2017, which partially offset the decrease in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Tennessee varies over time and is economically important not only from a beef production standpoint ($618.2 million), but also from the provision of ecosystem services ($297.5 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Tennessee Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$20.00
General Services (b)	$15.97
Wildlife Value (c)	$117.31
Total Value Per Acre: Private (a+b+c)	$153.28

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	1,940,851	2,168,359
Total Value Per Acre	$153.28	$153.28
Private Rangeland Value**	$297,490,468	$332,362,523
Beef Production Values		
Total Rangeland Values	$297,490,468	$332,362,523
Number of Beef Cows*	751,614	760,126
Value Per Beef Cow	$395.80	$437.25
Value Per Beef Cow	$395.80	$437.25
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.47	$0.52

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Texas

INTRODUCTION

The 2017 Census of Agriculture classified more than 135,700 agricultural operations in Texas as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 84.3 million acres of private land, including 70.3 million acres of pasture/rangeland. This land base represented nearly 71 percent of non-metro, non-urban land in Texas and supported close to 4 million head of beef cows in 2017. The production from these ranches generated $4.8 billion of gross revenue, including $4.3 billion from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $159.9 billion. Texas beef cattle ranches also employed nearly 440,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Texas beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Texas in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 87 percent of the beef cows and 80 percent of the total pasture/rangeland reported in the Census of Agriculture for Texas. The uncertainty regarding how much of the remaining 20 percent of pasture/rangeland is grazed by beef cattle rather than other types

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Texas beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Texas were estimated to be $6.60, $5.42, and $36.63 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $48.65 per acre of private pasture/rangeland. Applying these per acre values to the 70.3 million acres of private pasture/rangeland used by beef cattle ranches in Texas resulted in an estimated $3.4 billion in total ecosystem services provided annually. This represents an ecosystem services value of $856.08 per beef cow and $1.02 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 7 percent higher than estimates from 2012 ($3.4 billion vs. $3.2 billion) due to a 7-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 4 percent using 2017 data because the number of beef cows increased by 12 percent in 2017, which more than offset the increase in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Texas varies over time and is economically important not only from a beef production standpoint ($4.3 billion), but also from the provision of ecosystem services ($3.4 billion). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Texas Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$6.60
General Services (b)	$5.42
Wildlife Value (c)	$36.63
Total Value Per Acre: Private (a+b+c)	$48.65

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	70,295,826	65,593,996
Total Value Per Acre	$48.65	$48.65
Private Rangeland Value**	$3,419,782,951	$3,191,046,211
Beef Production Values		
Total Rangeland Values	$3,419,782,951	$3,191,046,211
Number of Beef Cows*	3,994,712	3,576,336
Value Per Beef Cow	$856.08	$892.27
Value Per Beef Cow	$856.08	$892.27
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$1.02	$1.06

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Utah

INTRODUCTION

The 2017 Census of Agriculture classified more than 5,900 agricultural operations in the Utah as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 3.6 million acres of private land, including 3.0 million acres of pasture/rangeland. They also utilized 14.9 million acres of Bureau of Land Management (BLM) land and 4.9 million acres of U.S. Forest Service (USFS) land. Combined, this land base represented 62 percent of non-metro, non-urban land in Utah and supported nearly 267,000 head of beef cows in 2017. The production from these ranches generated $306.1 million of gross revenue, including $269.4 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $7.2 billion. Utah beef cattle ranches also employed close to 25,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Utah beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated and expanded estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data and by including estimates of the ecosystem service value of cattle grazing on federal lands. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). Forage production values for federal rangelands associated with beef cattle ranching were calculated on a per acre basis from monthly per animal unit grazing fee rates for cattle (NASS, 2019). Specific information on the quantity of BLM grazing was obtained from the 2018 Public Land Statistics (BLM, 2019). Specific information on the quantity of USFS grazing was obtained from the FY 2016 Grazing Statistical Summary (USFS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem values of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. The total acres of federal rangeland were obtained through a GIS analysis of federal grazing allotments (Reeves, 2020). All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Utah in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms

(NAICS 112111).[1] These agricultural operations account for 79 percent of the beef cows and 35 percent of the total pasture/rangeland reported in the Census of Agriculture for Utah. The uncertainty regarding how much of the remaining 65 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and the acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Utah beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of federal forage production, private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Utah were estimated to be $0.96, $4.80, $4.93, and $24.90 per acre, respectively. Combining these four values yields an estimated total economic value of ecosystem services for beef cattle ranching of $30.79 per acre of federal rangeland and $34.63 per acre of private pasture/rangeland. Applying these per acre values to the 19.8 million acres of federal rangeland and the 3.0 million acres of private pasture/rangeland used by beef cattle ranches in Utah resulted in an estimated $713.8 million in total ecosystem services provided annually. This represents an ecosystem services value of $2,673.60 per beef cow and $3.18 per pound of retail beef. Results were also broken down into the relative contribution of these values from federal grazing (85 percent) versus private grazing (15 percent).

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 11 percent higher than estimates from 2012 ($103.7 million vs. $93.0 million) due to a 11-percent increase in private pasture/rangeland acres in 2017; however, the number of beef cows decreased slightly in 2017 and the value per beef cow and value per pound of beef increased by 2 percent on a per-head basis. The results indicate beef cattle ranching in Utah varies over time and is economically important not only from a beef production standpoint ($269.4 million), but also from the provision of ecosystem services ($713.8 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

Table 1. Value of Utah Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values		
Federal Forage (a)	$0.96	
Private Forage (b)	$4.80	
General Services (c)	$4.93	
Wildlife Value (d)	$24.90	
Total Value Per Acre: Federal (a+c+d)	$30.79	
Total Value Per Acre: Private (b+c+d)	$34.63	
Federal Rangeland Values		
Federal Rangeland (2017 Acres)	19,817,279	
Total Value Per Acre	$30.79	
Federal Rangeland Value (e)	$610,161,968	
Ag. Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	2,993,358	2,685,305
Total Value Per Acre	$34.63	$34.63
Private Rangeland Value (f)	$103,665,696	$92,997,233
Total Rangeland Values (e+f)**	**$713,827,664**	**$703,159,202**
% Contribution to Total Rangeland Value		
Federal (g)	85%	87%
Private (h)	15%	13%
Beef Production Values		
Total Rangeland Values (e+f)	$713,827,664	$703,159,202
Number of Beef Cows*	266,991	267,394
Value Per Beef Cow (i)	$2,673.60	$2,629.67
Value Per Beef Cow: Federal (i × g)	$2,285.33	$2,281.88
Value Per Beef Cow: Private (i × h)	$388.27	$347.79
Value Per Beef Cow	$2,673.60	$2,629.67
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef (j)	$3.18	$3.13
Value Per LB of Beef: Federal (j × g)	$2.72	$2.71
Value Per LB of Beef: Private (j × h)	$0.46	$0.41

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture. Data limitations precluded this same comparison for federal grazing.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Vermont

INTRODUCTION

The 2017 Census of Agriculture classified nearly 900 agricultural operations in Vermont as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 115,805 acres of private land, including 21,758 acres of pasture/rangeland. This land base represented over 2 percent of non-metro, non-urban land in Vermont and supported close to 7,000 head of beef cows in 2017. The production from these ranches generated $21.2 million of gross revenue, including $16.9 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $478 million. Vermont beef cattle ranches also employed nearly 3,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Vermont beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation, from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Vermont in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 45 percent of the beef cows and 19 percent of the total pasture/rangeland reported in the Census of Agriculture for Vermont. The uncertainty regarding how much of the remaining 81 percent of pasture/rangeland is grazed by beef cattle rather than other types

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Vermont beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Vermont were estimated to be $24.50, $15.93, and $51.46 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $91.89 per acre of private pasture/rangeland. Applying these per acre values to the 21,758 acres of private pasture/rangeland used by beef cattle ranches in Vermont resulted in an estimated $2.0 million in total ecosystem services provided annually. This represents an ecosystem services value of $285.82 per beef cow and $0.34 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 1 percent higher than estimates from 2012 ($1.999 million vs. $1.985 million) due to a 1-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 26 percent using 2017 data because the number of beef cows increased by 36 percent in 2017, which more than offset the increase in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Vermont varies over time and is economically important not only from a beef production standpoint ($16.9 million), but also from the provision of ecosystem services ($2.0 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Vermont Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$24.50
General Services (b)	$15.93
Wildlife Value (c)	$51.46
Total Value Per Acre: Private (a+b+c)	$91.89

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	21,758	21,606
Total Value Per Acre	$91.89	$91.89
Private Rangeland Value**	$1,999,317	$1,985,350
Beef Production Values		
Total Rangeland Values	$1,999,317	$1,985,350
Number of Beef Cows*	6,995	5,138
Value Per Beef Cow	$285.82	$386.41
Value Per Beef Cow	$285.82	$386.41
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.34	$0.46

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Virginia

INTRODUCTION

The 2017 Census of Agriculture classified more than 17,300 agricultural operations in Virginia as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 3.4 million acres of private land, including 1.4 million acres of pasture/rangeland. This land base represented nearly 16 percent of non-urban land in Virginia and supported close to 498,000 head of beef cows in 2017. The production from these ranches generated $611.9 million of gross revenue, including $538.9 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $15.5 billion. Virginia beef cattle ranches also employed more than 54,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Virginia beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Virginia in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 78 percent of the beef cows and 69 percent of the total pasture/rangeland reported in the Census of Agriculture for Virginia. The uncertainty regarding how much of the remaining 31 percent of pasture/rangeland is grazed by beef cattle rather than other types

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Virginia beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Virginia were estimated to be $20.00, $15.41, and $53.32 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $88.73 per acre of private pasture/rangeland. Applying these per acre values to the 1.4 million acres of private pasture/rangeland used by beef cattle ranches in Virginia resulted in an estimated $126.6 million in total ecosystem services provided annually. This represents an ecosystem services value of $254.37 per beef cow and $0.30 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 13 percent lower than estimates from 2012 ($126.6 million vs. $144.9 million) due to a 13-percent decrease in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by only 10 percent using 2017 data because the number of beef cows decreased by 3 percent in 2017, which partially offset the decrease in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Virginia varies over time and is economically important not only from a beef production standpoint ($538.9 million), but also from the provision of ecosystem services ($126.6 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Virginia Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$20.00
General Services (b)	$15.41
Wildlife Value (c)	$53.32
Total Value Per Acre: Private (a+b+c)	$88.73

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	1,426,873	1,633,083
Total Value Per Acre	$88.73	$88.73
Private Rangeland Value**	$126,607,820	$144,905,032
Beef Production Values		
Total Rangeland Values	$126,607,820	$144,905,032
Number of Beef Cows*	497,726	511,179
Value Per Beef Cow	$254.37	$283.47
Value Per Beef Cow	$254.37	$283.47
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.30	$0.34

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Washington

INTRODUCTION

The 2017 Census of Agriculture classified nearly 9,100 agricultural operations in the Washington as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 2.6 million acres of private land, including 1.9 million acres of pasture/rangeland. They also utilized 252,252 acres of Bureau of Land Management (BLM) land and 1.7 million acres of U.S. Forest Service (USFS) land. Combined, this land base represented over 10 percent of non-urban land in Washington and supported close to 170,000 head of beef cows in 2017. The production from these ranches generated $305.8 million of gross revenue, including $268.1 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $6.9 billion. Washington beef cattle ranches also employed more than 31,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Washington beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated and expanded estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data and by including estimates of the ecosystem service value of cattle grazing on federal lands. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). Forage production values for federal rangelands associated with beef cattle ranching were calculated on a per acre basis from monthly per animal unit grazing fee rates for cattle (NASS, 2019). Specific information on the quantity of BLM grazing was obtained from the 2018 Public Land Statistics (BLM, 2019). Specific information on the quantity of USFS grazing was obtained from the FY 2016 Grazing Statistical Summary (USFS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem values of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. The total acres of federal rangeland were obtained through a GIS analysis of federal grazing allotments (Reeves, 2020). All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Washington in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms

(NAICS 112111).[1] These agricultural operations account for 71 percent of the beef cows and 42 percent of the total pasture/rangeland reported in the Census of Agriculture for Washington. The uncertainty regarding how much of the remaining 58 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and the acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Washington beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of federal forage production, private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Washington were estimated to be $0.73, $8.00, $10.06, and $24.08 per acre, respectively. Combining these four values yields an estimated total economic value of ecosystem services for beef cattle ranching of $34.87 per acre of federal rangeland and $42.14 per acre of private pasture/rangeland. Applying these per acre values to the 1.9 million acres of federal rangeland and the 1.9 million acres of private pasture/rangeland used by beef cattle ranches in Washington resulted in an estimated $149.0 million in total ecosystem services provided annually. This represents an ecosystem services value of $878.49 per beef cow and $1.04 per pound of retail beef. Results were also broken down into the relative contribution of these values from federal grazing (45 percent) versus private grazing (55 percent).

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was 18 percent higher than estimates from 2012 ($81.3 million vs. $69.1 million) due to a 18-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef declined by 7 percent using 2017 data because the number of beef cows increased by 17 percent in 2017, which more than offset the increase in private pasture/rangeland values on a per-head basis. The results indicate beef cattle ranching in Washington varies over time and is economically important not only from a beef production standpoint ($268.1 million), but also from the provision of ecosystem services ($149.0 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

Table 1. Value of Washington Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values		
Federal Forage (a)	$0.73	
Private Forage (b)	$8.00	
General Services (c)	$10.06	
Wildlife Value (d)	$24.08	
Total Value Per Acre: Federal (a+c+d)	$34.87	
Total Value Per Acre: Private (b+c+d)	$42.14	
Federal Rangeland Values		
Federal Rangeland (2017 Acres)	1,941,483	
Total Value Per Acre	$34.87	
Federal Rangeland Value (e)	$67,691,126	
Ag. Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	1,929,493	1,638,702
Total Value Per Acre	$42.14	$42.14
Private Rangeland Value (f)	$81,303,885	$69,050,698
Total Rangeland Values (e+f)**	**$148,995,011**	**$136,741,824**
% Contribution to Total Rangeland Value		
Federal (g)	45%	50%
Private (h)	55%	50%
Beef Production Values		
Total Rangeland Values (e+f)	$148,995,011	$136,741,824
Number of Beef Cows*	169,604	145,163
Value Per Beef Cow (i)	$878.49	$941.99
Value Per Beef Cow: Federal (i × g)	$399.11	$466.31
Value Per Beef Cow: Private (i × h)	$479.37	$475.68
Value Per Beef Cow	$878.49	$941.99
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef (j)	$1.04	$1.12
Value Per LB of Beef: Federal (j × g)	$0.47	$0.55
Value Per LB of Beef: Private (j × h)	$0.57	$0.57

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture. Data limitations precluded this same comparison for federal grazing.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – West Virginia

INTRODUCTION

The 2017 Census of Agriculture classified more than 9,400 agricultural operations in West Virginia as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 1.9 million acres of private land, including 699,735 acres of pasture/rangeland. This land base represented nearly 19 percent of non-metro, non-urban land in West Virginia and supported close to 167,000 head of beef cows in 2017. The production from these ranches generated $168.3 million of gross revenue, including $145.7 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $5.1 billion. West Virginia beef cattle ranches also employed over 31,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of West Virginia beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in West Virginia in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 81 percent of the beef cows and 69 percent of the total pasture/rangeland reported in the Census of Agriculture for West Virginia. The uncertainty regarding how much of the remaining 31 percent of pasture/rangeland is grazed by beef cattle rather than

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

other types of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of West Virginia beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in West Virginia were estimated to be $12.50, $8.18, and $58.52 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $79.20 per acre of private pasture/rangeland. Applying these per acre values to the 699,735 acres of private pasture/rangeland used by beef cattle ranches in West Virginia resulted in an estimated $55.4 million in total ecosystem services provided annually. This represents an ecosystem services value of $332.74 per beef cow and $0.40 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 9 percent lower than estimates from 2012 ($55.4 million vs. $61.0 million) due to a 9-percent decrease in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 14 percent using 2017 data because the number of beef cows increased by 6 percent in 2017, which amplified the decrease in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in West Virginia varies over time and is economically important not only from a beef production standpoint ($145.7 million), but also from the provision of ecosystem services ($55.4 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of West Virginia Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$12.50
General Services (b)	$8.18
Wildlife Value (c)	$58.52
Total Value Per Acre: Private (a+b+c)	$79.20

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	699,735	770,410
Total Value Per Acre	$79.20	$79.20
Private Rangeland Value**	$55,417,717	$61,015,046
Beef Production Values		
Total Rangeland Values	$55,417,717	$61,015,046
Number of Beef Cows*	166,552	157,089
Value Per Beef Cow	$332.74	$388.41
Value Per Beef Cow	$332.74	$388.41
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.40	$0.46

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Wisconsin

INTRODUCTION

The 2017 Census of Agriculture classified nearly 10,500 agricultural operations in Wisconsin as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 1.3 million acres of private land, including 268,429 acres of pasture/rangeland. This land base represented more than 5 percent of non-metro, non-urban land in Wisconsin and supported more than 125,000 head of beef cows in 2017. The production from these ranches generated $753.4 million of gross revenue, including $580.7 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $6.8 billion. Wisconsin beef cattle ranches also employed over 34,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Wisconsin beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation, from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem value of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Wisconsin in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 44 percent of the beef cows and 28 percent of the total pasture/rangeland reported in the Census of Agriculture for Wisconsin. The uncertainty regarding how much of the remaining 72 percent of pasture/rangeland is grazed by beef cattle rather than other

1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the Census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

types of livestock precluded including data on the number of beef cows and acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Wisconsin beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Wisconsin were estimated to be $40.00, $22.59, and $62.82 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $125.42 per acre of private pasture/rangeland. Applying these per acre values to the 268,429 acres of private pasture/rangeland used by beef cattle ranches in Wisconsin resulted in an estimated $33.7 million in total ecosystem services provided annually. This represents an ecosystem services value of $269.07 per beef cow and $0.32 per pound of retail beef.

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two Censuses. In 2017, the total private rangeland value was 6 percent higher than estimates from 2012 ($33.7 million vs. $31.6 million) due to a 6-percent increase in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef decreased by 8 percent using 2017 data because the number of beef cows increased by 16 percent in 2017, which more than offset the increase in private pasture/rangeland on a per-head basis. The results indicate beef cattle ranching in Wisconsin varies over time and is economically important not only from a beef production standpoint ($580.7 million), but also from the provision of ecosystem services ($33.7 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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Table 1. Value of Wisconsin Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values	
Private Forage (a)	$40.00
General Services (b)	$22.59
Wildlife Value (c)	$62.82
Total Value Per Acre: Private (a+b+c)	$125.42

Ag Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	268,429	252,354
Total Value Per Acre	$125.42	$125.42
Private Rangeland Value**	$33,666,060	$31,649,952
Beef Production Values		
Total Rangeland Values	$33,666,060	$31,649,952
Number of Beef Cows*	125,122	107,913
Value Per Beef Cow	$269.07	$293.29
Value Per Beef Cow	$269.07	$293.29
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef	$0.32	$0.35

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture.

The Economic Value of Beef Cattle Ranching-Based Ecosystem Services – Wyoming

INTRODUCTION

The 2017 Census of Agriculture classified more than 4,900 agricultural operations in the Wyoming as beef cattle ranches and farms (USDA, 2019). These agricultural operations managed 21.0 million acres of private land, including 19.2 million acres of pasture/rangeland. They also utilized 14.9 million acres of Bureau of Land Management (BLM) land and 4.4 million acres of U.S. Forest Service (USFS) land. Combined, this land base represented nearly 70 percent of non-metro, non-urban land in Wyoming and supported close to 642,000 head of beef cows in 2017. The production from these ranches generated $844.6 million of gross revenue, including $753.3 million from the sale of cattle and calves. The value of land, buildings, machinery, and equipment associated with beef cattle ranches was estimated to be $15.1 billion. Wyoming beef cattle ranches also employed over 21,000 workers including producers, hired labor, and family labor in 2017.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses and may be affected by changes in land management. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Wyoming beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at the economic value of ecosystem services from beef cattle ranching nationally and across individual states.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's Prairie Provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of these attributes. Building on the work by Rashford et al. (2013), Taylor et al. (2019) estimated the economic value of several major aspects of beef cattle ranching-based ecosystem services from private land using readily available data, including the 2012 Census of Agriculture (USDA, 2014).

This report provides updated and expanded estimates of the ecosystem service values for forage production, general ecosystem services, and wildlife recreation from pasture/rangeland used for beef cattle production using 2017 Census of Agriculture data and by including estimates of the ecosystem service value of cattle grazing on federal lands. Forage production values for private pastures/rangelands associated with beef cattle ranching were based on National Agricultural Statistic Service (NASS) state average per acre pasture rental rate data (NASS, 2017). Forage production values for federal rangelands associated with beef cattle ranching were calculated on a per acre basis from monthly per animal unit grazing fee rates for cattle (NASS, 2019). Specific information on the quantity of BLM grazing was obtained from the 2018 Public Land Statistics (BLM, 2019). Specific information on the quantity of USFS grazing was obtained from the FY 2016 Grazing Statistical Summary (USFS, 2017). General ecosystem services values were based on the USDA's Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values were obtained from Taylor et al. (2019). These values were based on USFWS estimates of wildlife recreation days (USFWS, 2014) and USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016). The data from these two sources were combined to estimate the total ecosystem values of wildlife recreation. The wildlife recreation values were then converted to per acre estimates based on the number of non-metropolitan, non-urban acres (EPS, 2019). The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. The total acres of private pasture/rangeland were obtained from the 2017 Census of Agriculture. The total acres of federal rangeland were obtained through a GIS analysis of federal grazing allotments (Reeves, 2020). All dollar amounts were expressed in 2017 dollars. Results are presented in terms of value per acre, total value of ecosystem services, value per beef cow, and value per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Wyoming in part because not all ecosystem services can be readily quantified. Less commonly quantified services include biodiversity, carbon sequestration, supplying water, provision of alternative energy, and cultural benefits. In addition, to get an accurate estimate of pasture/rangeland acres used primarily for beef production as reported in the Census of Agriculture, the analysis only considers the number of pasture/rangeland acres and beef cows for

agricultural operations classified as beef cattle ranches and farms (NAICS 112111).[1] These agricultural operations account for 90 percent of the beef cows and 75 percent of the total pasture/rangeland reported in the Census of Agriculture for Wyoming. The uncertainty regarding how much of the remaining 25 percent of pasture/rangeland is grazed by beef cattle rather than other types of livestock precluded including data on the number of beef cows and the acres of pasture/rangeland from other types of agricultural operations in the analysis.

RESULTS

Table 1 summarizes the value of Wyoming beef cattle ranching ecosystem services using 2017 Census of Agriculture data. The per acre economic values of ecosystem services in terms of federal forage production, private forage production, general ecosystem services, and wildlife recreation from pasture/rangeland in Wyoming were estimated to be $1.79, $4.80, $3.79, and $13.26 per acre, respectively. Combining these four values yields an estimated total economic value of ecosystem services for beef cattle ranching of $18.84 per acre of federal rangeland and $21.85 per acre of private pasture/rangeland. Applying these per acre values to the 19.2 million acres of federal rangeland and the 19.2 million acres of private pasture/rangeland used by beef cattle ranches in Wyoming resulted in an estimated $782.1 million in total ecosystem services provided annually. This represents an ecosystem services value of $1,218.94 per beef cow and $1.45 per pound of retail beef. Results were also broken down into the relative contribution of these values from federal grazing (46 percent) versus private grazing (54 percent).

Data from the 2012 Agricultural Census were also included in Table 1 to show how the values can vary due to differences in the reported number of pasture/rangeland acres and number of beef cows between the two censuses. In 2017, the total private rangeland value was less than 1 percent lower than estimates from 2012 ($419.7 million vs. $420.5 million) due to a less than 1-percent decrease in private pasture/rangeland acres in 2017; however, the value per beef cow and value per pound of beef declined by 11 percent using 2017 data because the number of beef cows increased by 12 percent in 2017, which amplified the decrease in private pasture/rangeland values on a per-head basis. The results indicate beef cattle ranching in Wyoming varies over time and is economically important not only from a beef production standpoint ($753.3 million), but also from the provision of ecosystem services ($782.1 million). While it may not be appropriate to combine these two aspects of value, consideration of both provides a better understanding of the overall economic contribution of beef cattle ranching than just income generation alone.

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1 Other agricultural classifications produce beef cattle but also have a majority of their operation in other types of livestock or crop production. For example, nationally there were 11.4 million acres reported in the census in pasture and rangeland (not included in this valuation) under the sheep and goat farming industry classification, and while this industry produced 98,000 beef cows, it also had a total inventory of 3.4 million sheep and lambs and 1.6 million goats. There is no reliable way to assign the acres of pasture/rangeland to these different livestock types.

Table 1. Value of Wyoming Beef Cattle Ranching Ecosystem Services (2017$)

Per Acre Values		
Federal Forage (a)	$1.79	
Private Forage (b)	$4.80	
General Services (c)	$3.79	
Wildlife Value (d)	$13.26	
Total Value Per Acre: Federal (a+c+d)	$18.84	
Total Value Per Acre: Private (b+c+d)	$21.85	
Federal Rangeland Values		
Federal Rangeland (2017 Acres)	19,234,857	
Total Value Per Acre	$18.84	
Federal Rangeland Value (e)	$362,376,238	
Ag. Census Year	2017	2012
Private Rangeland Values		
Private Rangeland (Acres)*	19,207,660	19,244,065
Total Value Per Acre	$21.85	$21.85
Private Rangeland Value (f)	$419,704,936	$420,500,418
Total Rangeland Values (e+f)**	**$782,081,174**	**$782,876,657**
% Contribution to Total Rangeland Value		
Federal (g)	46%	46%
Private (h)	54%	54%
Beef Production Values		
Total Rangeland Values (e+f)	$782,081,174	$782,876,657
Number of Beef Cows*	641,607	573,823
Value Per Beef Cow (i)	$1,218.94	$1,364.32
Value Per Beef Cow: Federal (i × g)	$564.79	$631.51
Value Per Beef Cow: Private (i × h)	$654.15	$732.81
Value Per Beef Cow	$1,218.94	$1,364.32
LBS of Beef Production Per Cow	841	841
Value Per LB of Beef (j)	$1.45	$1.62
Value Per LB of Beef: Federal (j × g)	$0.67	$0.75
Value Per LB of Beef: Private (j × h)	$0.78	$0.87

* Beef Cattle Ranching and Farming (NAICS 112111)

** This comparison shows that results can vary by year according to the data reported in the Census of Agriculture. Data limitations precluded this same comparison for federal grazing.