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# Final Report

## Economic Impact of the North Dakota Forest Service

Prepared for the North Dakota Forest Service  
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## Executive Summary

The North Dakota Forest Service generates substantial economic gains for the North Dakota economy by providing technical assistance, education, and funding and through research, education, and outreach efforts. These efforts include programs that enhance fire safety, sustain and improve forests, aid fire departments, promote community forestry, and aid primary and secondary processors.

This report is an economic assessment of the North Dakota Forest Service for the year 2010. This assessment was developed by the University of Nebraska-Lincoln Bureau of Business Research as part of a larger study examining the impact of state forestry agencies in 4 states.

North Dakota Forest Service programs were found to have substantial economic impacts and public benefits. Table ES.1 lists the total annual economic impact of the North Dakota Forest Service measured in this study. The North Dakota Forest Service in 2010 had an economic impact of \$15,798,000. This impact included \$8,407,000 of labor income (wages, salaries, and benefits) spread over 188 jobs. There also was an associated state and local tax revenue impact of \$1,262,000.

Table ES.1  
Combined Economic Impact of 2010 North Dakota Forest Service Programs

Program Area	Direct Impact	Multiplier Impact	Total Impact
Output (Expenditures)	\$10,236,000	\$5,562,000	\$15,798,000
Labor Income	\$6,304,000	\$2,103,000	\$8,407,000
Employment	145	43	188

Source: Author's calculations.

Economic impacts in Table ES.1 are one part of the economic gains from North Dakota Forest Service programs. The other component is the public benefits of the programs from improved safety, a cleaner environment, and lower cost training opportunities. North Dakota Forest Service programs in 2010 produced public benefits of \$3,330,000.

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## **Chapter 1: Introduction**

The North Dakota Forest Service generates substantial economic gains for the North Dakota economy by providing technical assistance, education, and funding. These efforts include programs that enhance fire safety, sustain and improve forests, aid fire departments, promote community and rural forestry, improve forest health, and aid primary and secondary processors.

This report is an economic impact assessment of the North Dakota Forest Service. This assessment was developed by the University of Nebraska-Lincoln Bureau of Business Research as part of a larger study examining the impact of State Forestry Agencies in 4 states.

Chapter 2 considers the economic impact from the operations of the North Dakota Forest Service. This refers to the direct and total spending, labor income, and employment generated by expenditures to operate the NDFS and its programs. Chapter 3 examines the direct and total spending, labor income, and employment generated by pass-through funds of the North Dakota Forest Service. Chapter 4 looks at the economic impact of forest fuels reductions programs. Chapter 5 considers the economic gains of rural forestry and forest health programs, with emphasis on service to private forest landowners who own 70%<sup>1</sup> of the forest resources of North Dakota. Chapter 6 considers efforts by the fire management program to reduce the number and severity of wildfires, and aid rural fire districts. Chapter 7 provides a similar analysis of the economic consequences of community forestry programs. These programs provide critical training to green industry professionals and direct assistance that increases the economic value of North Dakota forest lands. Chapter 8 considers the economic impact of the conservation tree planting program and efforts to encourage forest product utilization. Chapter 9 provides a summary of project findings.

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<sup>1</sup> According to United States Forest Service FIA data

## **Chapter 2: Economic Impact from North Dakota Forest Service Operations**

North Dakota Forest Service employees deliver services to communities, rural fire departments, households, businesses and others located throughout the state. The North Dakota Forest Service (NDFS) exists to provide these services but it is also true that the operation of the NDFS creates a direct economic impact on the state of North Dakota. The wages and benefits of NDFS employees create a direct economic impact on the North Dakota economy as do expenditures for the ordinary operation of the NDFS including utilities, office supplies, travel, and other normal office expenses.

Beyond these direct economic impacts, the operations of the North Dakota Forest Service creates an additional economic impact in the state as each dollar of direct spending circulates further in the economy. For example, the NDFS purchases office equipment and supplies. These supply purchases support additional employment and business activity at a local business that provide these equipment and supplies. Employees of the NDFS also spend their paychecks at businesses throughout the community, again supporting more local business activity and employment. This additional economic activity is known as the multiplier effect.

This chapter examines both of these components of the economic impact from the operations of the North Dakota Forest Service. We focus on the economic impact of spending rather than the economic impact of the services themselves (these are a subject of later chapters). We first report the direct spending of the North Dakota Forest Service during 2010. We then include the economic multiplier effect of additional spending in the North Dakota economy and estimate the total economic impact from the operations of the North Dakota Forest Service.

### **Direct Economic Impact**

According to budget information provided by the North Dakota Forest Service, the NDFS received revenue of \$5.16 million during fiscal year 2010. Revenue came from federal sources, state sources, grants and tree sales. The North Dakota Forest Service further indicated that it had operations expenditures (salaries, benefits, supplies, travel, equipment, and other operations) of \$2.37 million during fiscal year 2010. Part of those annual expenditures supports the operation of the Towner State Nursery. We assume that \$499,000 went to support the nursery, since this was its annual revenue. The impact of this \$499,000 spending is examined in Chapter 8. This Chapter examines the economic impact of the other \$1.87 million in operating expenditures.

This \$1.87 million in expenditure on operations during fiscal year 2010 is the direct economic impact from operations. These direct economic impacts generate a multiplier impact. Economic multipliers are considered next.

### **Economic Multipliers**

Operations expenditures circulate further within the state economy, generating a “multiplier impact.” As noted earlier, the multiplier impact occurs as the North Dakota Forest Service purchases equipment and services from local businesses. The multiplier impact also occurs as employees of the NDFS spend their paychecks at North Dakota businesses for a full range of household purchases including housing, groceries, dining out, retail, insurance, and others. These types of multiplier impacts generate business receipts for business owners and wages for employees throughout the economy.

Mathematically, economic multipliers show the additional economic activity that occurs in North Dakota for each dollar of direct spending. The magnitude of the multiplier effect varies from state to state but typically each dollar of direct expenditure creates between \$0.20 and \$0.80 of additional multiplier spending. There are also multipliers available for labor income (wages and benefits). These multipliers show the additional labor income created for each dollar of direct labor income. Multipliers also can show the number of additional jobs created in a state economy for each direct job.

As noted earlier, the magnitude of economic multipliers vary from state to state. Typically, larger states with a more diverse economy have larger economic multipliers. Economic multipliers also vary by industry. Typically, higher wage industries, and industries that utilize more localized supplies, have large multiplier effects.

The fact that the magnitude of multipliers varies by state and by industry suggests that analysis requires a model to calculate economic multipliers on a case by case basis. The IMPLAN multiplier package developed by the Minnesota IMPLAN Group (MIG, Inc.) is such a multiplier package. The IMPLAN model is the leading economic multiplier package in use in the United States, and can be used to calculate economic multipliers for around 400 industries for each state, each U.S. county, and for combinations of counties and states. We also note that the IMPLAN model has been recently updated, and the BBR has substantial experience in utilizing the IMPLAN model. The UNL Bureau of Business Research has used the IMPLAN model to conduct dozens of economic impact studies.

We utilized the IMPLAN model to calculate economic multipliers for the State of North Dakota. The Minnesota IMPLAN group does not allow its clients to directly reveal the magnitude of its economic multipliers. However, we can report that the economic multipliers were in the range of 0.20 to 0.70.

**Multiplier Impact**

Table 2.1 shows the direct operations expenditure and the direct labor income (wages and benefits) of the North Dakota Forest Service (excluding Towner State Nursery) in fiscal year 2010. The Table also shows the multiplier impact and the total economic impact.

Table 2.1  
Fiscal Year 2010 Economic Impact from Operations of the North Dakota Forest Service

Program Area	Direct Impact	Multiplier Impact	Total Impact
Output (Expenditures)	\$1,870,000	\$824,000	\$2,694,000
Labor Income	\$1,614,000	\$271,000	\$1,885,000
Employment	22	8	30

Source: Budget information provided by the North Dakota Forest Service

The total economic impact is \$2,694,000 in terms of output (business receipts). This refers to either the expenditures of the NDFS or receipts of businesses that earn revenue due to the multiplier impact. The total economic impact in terms of labor income is \$1,885,000. Most of this total is the labor income (wages and benefits) of North Dakota Forest Service employees but a substantial level of income is earned by employees of businesses throughout the economy. Note that this labor income impact is a component of the total economic impact. The labor income impact should not be added to the output impact. The labor income impact of \$1,885,000 is spread over 30 jobs.

The substantial multiplier impact in Table 2.1 ensures that a large portion of the economic impact of NDFS operations occurs at private sector businesses rather than at the North Dakota Forest Service itself. This multiplier impact is likely to occur at businesses throughout the economy as the NDFS would make purchases from businesses in a variety of industries and NDFS employees would spend their wages at a full range of businesses. Table 2.2 demonstrates this by showing the economic impact of NDFS operations by industry.

Table 2.2  
Fiscal Year 2010 Economic Impact from the Operations of the North Dakota Forest Service  
By Detailed Industry

Industry	Total Output Impact	Total Labor Income Impact	Total Employment Impact
Agriculture	\$4,000	\$2,000	0
Mining	\$0	\$0	0
Utilities	\$24,000	\$4,000	0
Construction	\$8,000	\$3,000	0
Manufacturing	\$18,000	\$2,000	0
Wholesale Trade	\$44,000	\$18,000	0
Retail Trade	\$85,000	\$45,000	2
Transportation & Warehousing	\$18,000	\$7,000	0
Information	\$27,000	\$6,000	0
Financial Services	\$256,000	\$31,000	1
Business Services	\$38,000	\$17,000	0
Education and Health Care	\$177,000	\$88,000	2
Recreation and Amusement	\$11,000	\$4,000	0
Hospitality	\$49,000	\$16,000	1
Other Services	\$42,000	\$21,000	1
Government	\$1,894,000	\$1,621,000	22

Source: Author's calculations

Note: Totals may not sum due to rounding

The largest impact is in government, the industry that captures the direct impact given that the North Dakota Forest Service is a part of North Dakota State University. There is a multiplier impact of tens of thousands of dollars or perhaps even a few hundred thousand dollars in most other major industry groups. Among the other industries, the largest economic impact occurs in the financial services sector. The operations of the North Dakota Forest Service had an estimated \$256,000 impact on the financial services sector in fiscal year 2010, including \$31,000 in labor income. These wages and benefits are spread over 1 job. Few jobs are created in this industry because part of the economic impact is spent on real estate purchases. The next largest impact was on the education and health care sector. The impact on education and health care was \$177,000, including \$88,000 in labor income spread over 2 jobs. The operations of the North Dakota Forest Service had an economic impact of \$85,000 on the retail trade industry, including \$45,000 in labor income spread over 2 jobs.

The economic impact captured in Tables 2.1 and 2.2 also should create an impact on tax revenue. Increased employment and business activity generate income, sales, and property taxes as well as a variety of other taxes and fees. The IMPLAN software also generates an estimate of tax revenue impacts. These tax revenue impacts are reflected in Table 2.3 below.

Table 2.3  
Fiscal Year 2010 State and Local Tax Revenue Impact from the Operations  
of the North Dakota Forest Service

Type of Tax	Revenue
Dividends	\$34,000
Social Ins Tax- Employee Contribution	\$5,000
Social Ins Tax- Employer Contribution	\$12,000
Indirect Bus Tax: Sales Tax	\$17,000
Indirect Bus Tax: Property Tax	\$11,000
Indirect Bus Tax: Motor Vehicle License	\$3,000
Indirect Bus Tax: Severance Tax	\$0
Indirect Bus Tax: Other Taxes	\$5,000
Indirect Bus Tax: S/L Non-Taxes	\$11,000
Corporate Profits Tax	\$15,000
Personal Tax: Income Tax	\$143,000
Personal Tax: Non-Taxes (Fines- Fees	\$24,000
Personal Tax: Motor Vehicle License	\$15,000
Personal Tax: Property Taxes	\$1,000
Personal Tax: Other Tax (Fish/Hunt)	\$6,000
Total State and Local Tax	\$300,000

Source: Author's calculations.

The total state and local tax revenue impact from the operations of the North Dakota Forest Service in fiscal year 2010 was \$300,000. Around two-thirds of this impact was due income taxes, including dividend taxes. The remaining tax revenue was spread across property taxes, sales taxes, and a variety of employee contributions, licenses, and fees.

## **Chapter 3: Total Economic Impact from Pass-Through Funds**

The North Dakota Forest Service administers state and federal funds that support initiatives throughout the state. Setting aside for the moment the benefits of these programs and initiatives, these “pass through” dollars generate a direct economic impact on the North Dakota economy by supporting employment and business activity at businesses and agencies that receive this funding.

This Chapter enumerates the direct economic impact on North Dakota from “pass-through” spending of the North Dakota Forest Service. We also examine the additional economic activity, or multiplier impact, which occurs as a result of this direct economic impact. Such additional economic activity occurs because each dollar of direct impact circulates further in the state economy. As in Chapter 2, the total economic impacts will be presented in terms of output (i.e., business or agency receipts), employment, and labor income (wages, salaries, and benefits). The tax revenue impact will be presented in terms of state and local tax revenue.

### **Direct Economic Impact**

Budget information provided by the North Dakota Forest Service (NDFS) included detailed information about revenue and expenditures. The budget report noted \$5.16 million in revenue for fiscal year 2010 and \$2.37 million in expenditures on the operation of the North Dakota Forest Service, including the Tower State Nursery. The preceding chapter and Chapter 8 focus on the economic impact of that \$2.37 million in operations spending. This considers the potential economic impact from the additional \$2.79 million of funds. Table 3.1 provides the total economic impact associated with this \$2.79 million in direct impact.

## Multiplier Impact

The IMPLAN model was again used to calculate economic multipliers for the State of North Dakota. These economic multipliers were then applied to the direct impact of \$2.79 million to produce the total economic impact estimates reported in Table 3.1.

Table 3.1  
Fiscal Year 2010 Economic Impact from Pass-Through Funds Distributed  
by the North Dakota Forest Service

Program Area	Direct Impact	Multiplier Impact	Total Impact
Output (Expenditures)	\$2,792,000	\$1,219,000	\$4,011,000
Labor Income	\$2,172,000	\$704,000	\$2,876,000
Employment	53	12	65

Source: Author's calculations.

The total economic impact is \$4,011,000 in terms of output (business receipts). The total economic impact in terms of labor income is \$2,876,000. This labor income impact is spread over 65 jobs, suggesting an average earnings of approximately \$44,200.

Table 3.2 shows the total economic impact by industry. Among the largest impacts are agriculture (which includes forestry) and government, the directly impacted sectors. Among other sectors, the largest economic impact is in the business services sector. There was a \$589,000 impact on the business services sector including \$200,000 in income spread over 13 job. There was a \$342,000 impact on the financial services sector.

Table 3.3 shows the fiscal year 2010 state and local tax revenue impact associated with the \$4,011,000 economic impact. The total state and local tax revenue impact was \$399,000. Nearly two-thirds of this impact was due to income taxes, included dividends. The remaining tax revenue was spread across sales tax, property tax, and a variety of employee contributions, licenses, and fees.

Table 3.2  
Fiscal Year 2010 Economic Impact of Pass-Through Funds of the North Dakota Forest Service  
By Detailed Industry

Industry	Total Output Impact	Total Labor Income Impact	Total Job Impact
Agriculture	\$566,000	\$80,000	3
Mining	\$0	\$0	0
Utilities	\$34,000	\$5,000	0
Construction	\$12,000	\$5,000	0
Manufacturing	\$46,000	\$6,000	0
Wholesale Trade	\$70,000	\$29,000	0
Retail Trade	\$98,000	\$53,000	2
Transportation & Warehousing	\$31,000	\$12,000	0
Information	\$50,000	\$11,000	0
Financial Services	\$342,000	\$46,000	2
Business Services	\$589,000	\$200,000	13
Education and Health Care	\$204,000	\$101,000	2
Recreation and Amusement	\$15,000	\$6,000	0
Hospitality	\$67,000	\$21,000	1
Other Services	\$59,000	\$30,000	1
Government	\$1,827,000	\$1,546,000	38

Source: Author's calculations Note: Totals may not sum due to rounding

Table 3.3  
Fiscal Year 2010 State and Local Tax Revenue Impact of Pass-Through Funds of the NDFS

Type of Tax	Revenue
Dividends	\$56,000
Social Ins Tax- Employee Contribution	\$5,000
Social Ins Tax- Employer Contribution	\$13,000
Indirect Bus Tax: Sales Tax	\$30,000
Indirect Bus Tax: Property Tax	\$20,000
Indirect Bus Tax: Motor Vehicle License	\$5,000
Indirect Bus Tax: Severance Tax	\$0
Indirect Bus Tax: Other Taxes	\$9,000
Indirect Bus Tax: S/L Non-Taxes	\$19,000
Corporate Profits Tax	\$24,000
Personal Tax: Income Tax	\$165,000
Personal Tax: Non-Taxes (Fines- Fees	\$28,000
Personal Tax: Motor Vehicle License	\$17,000
Personal Tax: Property Taxes	\$0
Personal Tax: Other Tax (Fish/Hunt)	\$7,000
Total State and Local Tax	\$399,000

Source: Author's calculations.

## Chapter 4: Forest Fuel Reduction Programs

Forest fuels reduction grants both improve fire safety and incentivize additional business activity, including spending by private landowners. Specifically, by significantly lowering the cost to landowners of engaging in fuel reduction activities,<sup>2</sup> cost share grants encourage landowners to undertake fuels reduction projects on a larger number of acres. In this Chapter, we estimate the economic impact of the additional spending by private landowners or other businesses which is incentivized by forest fuels reduction programs. We also estimate the fire damage avoided by owners of land and structures in North Dakota due to forest fuels reduction efforts. Reduced fire damage improves safety for individuals and raises property values and property tax revenue.

### Economic Impact

Table 4.1 below shows the state or federal dollars provided for fuel treatment matching grants, the private dollars spent to match a grant and the total number of acres treated. North Dakota spent \$505 thousand in public dollars matched by almost \$330 thousand in private spending in the year 2010. There were 1,160 acres treated that year.

Table 4.1  
Total Fuel Treatment Grants Information

	Federal or State Dollars	Matching Private Dollars	Acres
North Dakota <sup>1</sup>	\$504,826	\$328,443	1,160

<sup>1</sup> Data provided by North Dakota Fire Manager

The private matching spending of \$328,000 is one economic impact of the forest fuels reduction program. This is a measure of additional private spending that is incentivized by the forest fuels reduction programs of the North Dakota Forest Service. Other impacts result from improved productivity. Acres that are thinned during forest fuels reduction are also more productive for years into the future. This occurs due to greater potential for grazing, and improved usage and potential for higher rents as a hunting area. The economic impact from acres thinned or placed under forest management would be \$175/acre when considering the value of improved grazing and hunting revenues over the next decade. The direct effect from a \$175

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<sup>2</sup> In the case of the USFS Adjacent Lands Funds, there is a 100% cost share.

impact on 1,160 acres treated during 2009 was \$203,000. Therefore the annual direct economic impact is \$531,000 dollars including both private contributions to forest fuels reduction and the improved value of the land for grazing and hunting. The \$531,000 represents the additional direct economic activity generated from the forest fuels reduction program on top of the North Dakota Forest Service spending on forest fuels reduction that were captured as part of the economic impacts in Chapters 2 and 3. Table 4.2 reports the total economic impact associated with this \$531,000 direct impact for 2010.

Table 4.2  
2010 Additional Economic Impact from the Forest Fuels Reduction Program

Program Area	Direct Impact	Multiplier Impact	Total Impact
Output (Expenditures)	\$531,000	\$266,000	\$797,000
Labor Income	\$73,000	\$86,000	\$159,000
Employment	4	2	6

Source: Author's calculations

The total economic impact is \$0.80 million in 2010, including \$159,000 in labor income spread over 6 jobs. This is an average income per job of \$26,500. As noted earlier, this additional economic impact can be added to the economic impact estimates from Chapter 2 and Chapter 3 of this report.

Table 4.3 shows the total economic impacts by industry. The largest impact is in agriculture (which includes forestry), the directly impacted sector. Among other sectors, the largest economic impact is in recreation and amusement. There was a \$100,000 impact on the recreation and amusement sector including \$39,000 in income. There was a \$53,000 impact on the financial services sector.

Table 4.3  
2010 Additional Economic Impact from the Forest Fuels Reduction Program  
By Detailed Industry

Industry	Total Output Impact	Total Labor Income Impact	Total Employment Impact
Agriculture	\$507,000	\$62,000	2.6
Mining	\$0	\$0	0.0
Utilities	\$8,000	\$1,000	0.0
Construction	\$2,000	\$1,000	0.0
Manufacturing	\$24,000	\$2,000	0.0
Wholesale Trade	\$22,000	\$9,000	0.1
Retail Trade	\$8,000	\$4,000	0.0
Transportation & Warehousing	\$11,000	\$4,000	0.0
Information	\$7,000	\$2,000	0.0
Financial Services	\$53,000	\$9,000	0.2
Business Services	\$19,000	\$9,000	0.0
Education and Health Care	\$16,000	\$8,000	0.0
Recreation and Amusement	\$100,000	\$39,000	2.1
Hospitality	\$6,000	\$2,000	0.1
Other Services	\$9,000	\$5,000	0.0
Government	\$5,000	\$2,000	0.0

Source: Author's calculations

Note: Totals may sum due to rounding

Table 4.4 shows the state and local tax revenue impact associated with the \$0.80 million economic impact. Total state and local tax revenue impact was \$60,000. Nearly 1/2 of this impact was due to income taxes, including dividend taxes. Around 1/6 of the revenue also was due to sales taxes while around 1/8 is due to property taxes. The remaining tax revenue was spread across a variety of employee contributions, licenses, and fees.

Table 4.4  
2010 Additional State and Local Tax Revenue Impact  
from the Forest Fuels Reduction Program

Type of Tax	Revenue
Dividends	\$9,000
Social Ins Tax- Employee Contribution	\$0
Social Ins Tax- Employer Contribution	\$1,000
Indirect Bus Tax: Sales Tax	\$10,000
Indirect Bus Tax: Property Tax	\$7,000
Indirect Bus Tax: Motor Vehicle License	\$2,000
Indirect Bus Tax: Severance Tax	\$0
Indirect Bus Tax: Other Taxes	\$3,000
Indirect Bus Tax: S/L Non-Taxes	\$7,000
Corporate Profits Tax	\$4,000
Personal Tax: Income Tax	\$13,000
Personal Tax: Non-Taxes (Fines- Fees	\$2,000
Personal Tax: Motor Vehicle License	\$1,000
Personal Tax: Property Taxes	\$0
Personal Tax: Other Tax (Fish/Hunt)	\$1,000
Total State and Local Tax	\$60,000

Source: Author's calculations.

Beyond these economic impacts, there are also other economic gains for the North Dakota economy from both public funds and matching private spending on forest fuels reduction. In particular, there are gains from a reduced risk of fires. These gains are outlined below.

### **Economic Benefits**

The reduced fire risk that results from the forest fuels programs provides benefits to North Dakota. In particular, there are savings to property, including forest land and buildings. Most importantly, there is a reduced risk of firefighter injury. These issues are examined in this section.

### **Annual Savings**

#### *Value of Land*

Analysis of the information in Table 4.1 above indicates that about 1,160 acres were treated in 2010. This effort was concentrated in Slope and Rolette counties. The Slope County

assessor’s office indicates that there was a recent purchase of 640 acres for \$100 per acre. To determine the value of land saved, the number of treated acres is multiplied by the value per acre and then by the probability that an acre would have burned. Estimates of the probability that an acre would burn are based on data from the State of Nebraska.<sup>3</sup> The results are shown in Table 4.5 below and indicate that forest fuel reduction saved land worth an estimated \$254 annually.

Table 4.5  
Value of Land Saved

	Treated Acres	Value per Acre	Probability of Fire	Value of Land Saved
ND	1,160	\$100	0.22%	\$254

For tax purposes, Slope and Rolette Counties value treed land the same as agricultural land, at about \$5 per acre and this value is used for real estate purposes. In North Dakota, effective property tax rates typically range between one and two percent. Individual county tax rates in 2009 were obtained, and an average tax rate of 22 percent on assessed values was calculated for the Rolette and Slope county area. Multiplying the number of treated acres by the tax value per acre and then by levy rate and the probability that an acre would have burn indicates that the resulting annual real estate taxes saved equal approximately \$3 in North Dakota. These results are shown in Table 4.6 below.

Table 4.6  
Property Tax Revenues Saved

	Treated Acres	Tax Value per Acre	Tax Levy	Probability of Fire	Tax Value of Land Saved
ND	1,160	\$5	0.22	0.22%	\$3

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<sup>3</sup> Data from Nebraska are used to estimate the probability of an acre being burned in the four-state area. According to data from the Nebraska Forest Service, Nebraska concentrates its fire fuel reduction program into the eleven counties in the north central and north western part of the state. Those counties are Dawes, Sheridan, Box Butte, Sioux, Cherry, Brown, Keya Paha, Rock, Banner, Morrill and Scotts Bluff. The Nebraska Forest Service (NFS) collects data on fires organized by fire district. For each reported fire, the NFS data include the fire district, year, suspected source and acres burned. The fire districts were overlain onto counties to determine the fire districts in the 11-county region. Data on fires in the relevant fire districts were acquired for the years 2000 through 2009.<sup>3</sup> Using this data, it was possible to determine that on average, 26,305 acres burned per year in the 11-county region. Census data indicate that the 11-county region encompasses a little over 12 million acres. Dividing average acres burned by total area indicates that approximately .22 percent, or a little less than one quarter of one percent of the region burned in any year.

*Value of Structures*

Homes are saved when forest fuel reduction efforts reduce the number of fires. The annual value of homes saved is estimated in Table 4.7 below. The estimation considers the average value of homes and the decline in the number of homes lost as acres are treated each year in the forest fuels reduction program. The average value of homes is calculated using Census data. Census data show that average median home value, in each of North Dakota’s relevant counties in 2008. Weighting each county’s median value by its population produces a weighted average median value of a rural detached home. In North Dakota, that value was \$77,760 as shown in Table 4.7, below. The expected decline in the number of homes burned each year is determined by multiplying the number of acres treated (1,160), by the probability that untreated acres would burn in a year (0.22%) by the probability that a home would be lost per acre burned (0.0027%). This probability was estimated based on data from the State of Nebraska.<sup>4</sup> The forest fuels program therefore prevents 0.00008 homes from being burned each year. Multiplying this percentage by the average value per home yields and estimate that the forest fuels programs saves \$5 in potential home losses each year. Multiplying the \$5 in savings by the average effective real estate tax rate of 1.1 percent (a 5% assessment rate and a 22% tax rate on assessed property) generates very close to \$0 in savings from fuel reduction programs. Thus, forest fuels reduction does not yield great savings in terms of structures saved. However, as is seen below, there are additional savings in terms of lives saved.

Table 4.7  
Value of Housing Saved

	Avg. Value per House	Annual Treated Acres	Prob of Fire	Probability of a Fire Taking a House	Affected Households	Value Saved	Real Estate Tax Rate	Tax Saving
ND	\$77,760	1,160	0.22%	0.0027%	0.00007	\$5	1.1%	\$0

<sup>4</sup> Data from the Nebraska forest service indicates that wildfires burned 72,696 acres during 2009 (Nebraska Forest Service Annual Report, 2009). Discussions with the Nebraska Forest Service indicated that approximately 20 homes were lost to forest fires over the last decade, or 2 per year. This suggests that .000027 homes are lost per acre burned in a forest fire.

*Value of Lives Saved*

Based on the research literature, from 1990 through 1998, an average of 4.5 people died per million acres of Wildland fires.<sup>5</sup> The U.S. Department of Transportation values a life at approximately \$5.8 million. The U.S. Environmental Protection Agency estimates the value of a statistical life at \$6.9 million. A value of \$6 million will be used in this analysis. Table 4.8 below shows that when the lives lost per million acres of fire is multiplied by the acres treated, then by the value of a life and the probability that an acre will burn, the dollar value of annual lives saved is \$69 in North Dakota.

Table 4.8  
Value of Lives Saved

	Deaths per Million Acres of Fire	Acres Treated	Value of a Life (million)	Probability of a Fire	Value of Lives Saved
ND	4.5	1,160	6	0.22%	\$69

*Aggregate Annual Impact*

Table 4.9 below shows the aggregate impact across the four-state region of the Forest Fuels reduction program. That impact is \$331 per year.

Table 4.9  
Aggregate Annual Impact of Fuel Reduction Program

Land	Property Tax Revenue	Homes Saved	Property Tax	Value of Lives	Total
\$254	\$3	\$5	\$0	\$69	\$331

**Present Discounted Value of Annual Savings**

The annual saving in the first year from forest fuel reduction is \$331. That saving will decay as forest fuels re-grow. A non-linear decay function is developed that has increasing decay rates, starting with little decay the first year and complete loss of any savings after 15 years.<sup>6</sup> With a 3 percent inflation rate and a 5 percent discount rate, the present discounted value of one year’s worth of forest fuel reduction is \$2,520.

<sup>5</sup> See Mason, L.C. et al. 2006. *Investments in Fuel Removals to Avoid Forest Fires Result in Substantial Benefits*. *Journal of Forestry*: 27-31.

<sup>6</sup> The decay function is  $1 - (a - bt - ct^2)$  where  $t$  is the years since the fuel removal occurred. Values for the parameters are  $a = 1$ ,  $b = .01$  and  $c = (a - bT)/T^2$ , where  $T$  is the number of years until all savings are lost, or in this case, 15 years. The number of years until all savings are lost depends on the relative precipitation in an area. The NFS estimates it to be up to 25 years in the relatively dryer western part of the state and only 10 years in the Niobrara Valley area.

## Chapter 5: Rural Forestry and Forest Health

Rural forestry programs work to sustain the forest resource base and increase the productivity of forest lands and windbreaks through training, and by providing technical assistance and management plans. Forest health programs provide diagnostic and inspection services, including large scale gypsy moth and emerald ash borer surveys. In North Dakota, this broad group of services encompasses the activities of the rural forestry and forest health programs within the North Dakota Forest Service.

The direct training, diagnostic, inspection, and planning services offered by the rural forestry and forest health programs aid broad sectors of the economy including forest landowners, agricultural producers, and owners of recreation property. Improved output from forest land and gains to agricultural producers from windbreaks also serves to create an economic impact. This Chapter measures these economic impacts and benefits.

### Economic Impact

Efforts to improve the health and management of forests and windbreaks can improve the output and value of tree and forest resources. The marginal contribution of tree inspections, management plans, and other rural forestry services to productivity, however, can be difficult to measure and document. The economic impact analysis that follows, as a result, will focus on impacts that can be documented such as the economic impact from new tree plantings or the savings and hunting values from maintaining windbreaks. Table 5.1 shows the number of acres served in 2010 by each type of North Dakota Forest Service program.

Table 5.1  
Acres Impacted By Programs

Program	Acres Impacted	Value Per Acre	Total Value
Forest Stewardship Tax Law	41,964	\$74	\$831,000
Management Plans	910	\$345	\$314,000
Landowner Technical Assistance	634	\$346	\$219,000
<b>Total</b>			<b>\$1,364,000</b>

Source: North Dakota Forest Service

The estimated value of acres enrolled in the Forest Stewardship Tax Law program arises from the recreational and amenity value of land that remains as forest. We estimated annual gains of \$20 per acre per year by maintaining land as forest by prohibiting “clearing, grazing, burning and destructive cutting” ([www.ndsu.edu/ndfs/rural\\_landowners/](http://www.ndsu.edu/ndfs/rural_landowners/)). As of January 1, 2011, there were 41,964 acres enrolled in the program and receiving a tax benefit in the 8 eligible counties of Benson, Cavalier, Grand Forks, Nelson, Pembina, Ramsey, Walsh and Wells. The direct impact from a \$20 effect on 41,964 acres was \$831,000, as seen in Table 5.1.

Acres that are placed under a forest management plan become more productive. This occurs due to higher yields, greater potential for grazing, and improved usage and potential for higher rents as a hunting area. The economic impact from acres placed under forest management would be \$345/acre when considering such long-term potential. The annual direct impact from a \$345 impact on an annual average of 910 acres was \$314,000.

The improved management practices associated with landowner technical assistance also yields gains due to higher yields and other activities. The estimated economic impact is also \$345/acre, as seen in Table 5.1. The North Dakota Forest Service indicated that there were 254 landowner technical assists during 2010. Data from nearby states suggests an average of 2.5 acres covered per technical assist for an estimated 634 acres impacted by technical assists. Applying the direct impact of \$345 per acre on 634 acres yields a direct impact estimate of \$219,000.

The aggregate direct impact of from the Forest Stewardship Tax Law program, forest management plans and technical assists was \$1,364,000. Table 5.2 reports the total economic impact associated with this direct impact. The total economic impact is \$1,885,000 in 2010, including \$551,000 in labor income spread over 24 jobs. This is an average income per job of \$23,000.

Table 5.2  
Economic Impact from 2010 Rural Forestry and Forest Health Programs

Program Area	Direct Impact	Multiplier Impact	Total Impact
Output (Expenditures)	\$1,364,000	\$521,000	\$1,885,000
Labor Income	\$349,000	\$202,000	\$551,000
Employment	18	6	24

Source: Author’s calculations

Table 5.3 shows the economic impact by industry. All results are total impacts. The largest impacts are in agriculture (which includes forestry) and recreation, the directly impacted sectors. Among other sectors, the largest economic impact is in the financial services sector. There was a \$158,000 impact on the financial services including \$26,000 in income. There was a \$55,000 impact on the education and health care sector.

Table 5.3

Economic Impact from 2010 Rural Forestry and Forest Health Programs by Detailed Industry

Industry	Total Output Impact	Total Labor Income Impact	Total Employment Impact
Agriculture	\$638,000	\$101,000	4
Mining	\$0	\$0	0
Utilities	\$25,000	\$4,000	0
Construction	\$7,000	\$3,000	0
Manufacturing	\$33,000	\$4,000	0
Wholesale Trade	\$43,000	\$18,000	0
Retail Trade	\$55,000	\$30,000	1
Transportation & Warehousing	\$24,000	\$9,000	0
Information	\$26,000	\$6,000	0
Financial Services	\$158,000	\$26,000	1
Business Services	\$60,000	\$27,000	1
Education and Health Care	\$55,000	\$27,000	1
Recreation and Amusement	\$697,000	\$271,000	15
Hospitality	\$20,000	\$6,000	0
Other Services	\$25,000	\$13,000	0
Government	\$19,000	\$6,000	0.0

Source: Author's calculations

Note: Totals may not sum due to rounding

Table 5.4 shows the state and local tax revenue impact associated with the \$1,885,000 economic impact. The state and local tax revenue impact was \$185,000. Nearly 1/2 of this impact was due to income taxes, including dividend taxes. Around 1/6<sup>th</sup> of the revenue also was due to sales taxes and 1/9<sup>th</sup> to property taxes. The remaining tax revenue was spread across a variety of employee contributions, licenses, and fees.

Table 5.4  
State and Local Tax Revenue Impact from 2010 Rural Forestry and Forest Health Programs

Type of Tax	Revenue
Dividends	\$25,000
Social Ins Tax- Employee Contribution	\$1,000
Social Ins Tax- Employer Contribution	\$3,000
Indirect Bus Tax: Sales Tax	\$32,000
Indirect Bus Tax: Property Tax	\$21,000
Indirect Bus Tax: Motor Vehicle License	\$5,000
Indirect Bus Tax: Severance Tax	\$0
Indirect Bus Tax: Other Taxes	\$9,000
Indirect Bus Tax: S/L Non-Taxes	\$21,000
Corporate Profits Tax	\$11,000
Personal Tax: Income Tax	\$43,000
Personal Tax: Non-Taxes (Fines- Fees	\$7,000
Personal Tax: Motor Vehicle License	\$4,000
Personal Tax: Property Taxes	\$0
Personal Tax: Other Tax (Fish/Hunt)	\$2,000
Total State and Local Tax	\$185,000

Source: Author's calculations.

Beyond these economic impacts, there are also other gains for the North Dakota economy from rural forestry and forest health programs. These gains are outlined below.

### Benefits

Table 5.5 shows the annual training, diagnosis and inspection activity associated with the rural forestry and forest health programs. There were 250 trained in North Dakota Forest Service rural forestry or forest health programs during 2010, according to the North Dakota Forest Service. There are also 658 assists per year. Assists included landowner technical assists, management plans, or diagnoses of insects or diseases.

Table 5.5  
Annual Program Activity

	Number Trained	Number Assisted
Rural Forestry	250	658

Source: North Dakota Forest Service 2010

By providing training and assists as a public service (or in some cases at a nominal cost), the rural forestry and forest health programs provide benefits to trainees and landowners. Such benefits are an important economic gain from NDFS programs. These public benefits are measured below. Specifically, one estimate of these benefits is the price charged for such training, technical assists, and plans by private for-profit service providers. The average costs for these services could be multiplied by the total number of persons receiving training, or assistance to yield the total benefit realized. Table 5.6 shows the estimated benefits of training programs provided by the rural forestry program in 2010, using this approach. The number trained is multiplied by the estimated private cost of providing such training. Average costs were estimated via an internet search for reported prices. These efforts yielded an estimated average price of \$130 per training class for rural forestry or forest health training programs. Using this market value, the estimated value of rural forestry training programs during 2010 was \$32,500.

Table 5.6  
Benefits of 2010 Rural Forestry and Forest Health Training Programs

	Number Trained	Private Market Value Per Training Session	Annual Benefit of Training During 2010
Rural Forestry	2,50	\$130	\$32,500

Source: Author's calculations

A similar approach was used to estimate the value of assists by rural forestry and forest health programs. An internet search of market prices for insect or disease diagnosis tree inspection assists provided an average cost of \$125 an hour. This analysis assumes an average visit of two hours (the review of private tree services indicated a 1 hour minimum for visits). In Table 5.7, an average cost of \$250 is applied to the 285 diagnoses during 2010. The total estimated value of these services was \$71,250 in 2010. This rate is also used for site visits by rural foresters for landowner technical assists. In these assists, rural foresters assess forest lands and provide verbal advice to forestland owners. There were also 119 management plans created on average per year over the last decade, according to the North Dakota Forest Service. This annual average is applied for 2010. We gathered cost information for states such as Ohio and Michigan and conservatively estimated that the full cost for a privately provided forest management plan would average around \$500. This value was utilized for the 119 forest

management plans. Calculations in Table 5.7 indicate that the forest management plans provide benefits of \$59,500 in 2010. The total estimated value of assists from the rural forestry program was \$194,250.

Table 5.7  
Benefits of 2010 Rural Forestry and Forest Health Assists

	Number Assisted	Private Market Value Per Assist	Annual Benefit of Assists During 2010
Insect or disease diagnosis	285	\$250	\$71,250
Landowner technical assists	254	\$250	\$63,500
Management plans	119	\$500	\$59,500
Total	658		\$194,250

Source: Author's calculations

### **Conclusion**

This chapter estimated the economic impact and benefits flowing from the rural forestry and forest health programs. The findings were that in 2010 the rural forestry and forest health programs generated an economic impact of \$1,885,000 and also yielded public benefits of \$227,000. These economic impacts and benefits should be added towards the total reported for the North Dakota Forest Service in the final chapter of the report.

## **Chapter 6: Fire Management**

The North Dakota Forest Service makes a substantial contribution to rural fire districts throughout the state. This is accomplished through training of firefighters, planning to reduce fire risk, and by providing surplus equipment to rural fire district. The latter policy makes it possible for a larger number of effective fire fighting districts to exist throughout rural North Dakota, which lowers response times and helps contain fires. Prevention and planning also reduce the size of fires that do occur. The net effect of these efforts in is to reduce the size of fires, reduce the risk to fire fighters and the number of acres burned. Improved safety and smaller fires in turn provide benefits throughout North Dakota in terms of fewer injuries, fewer homes lost to fire, and higher property values for agricultural lands. There is also an impact on economic output and employment as more acres of North Dakota land stay in production rather than being lost for a period due to rural fires.

This chapter assesses these economic benefits and impacts from the range of efforts of the North Dakota Forest Service's fire management program. The next section provides a description of fire management programs offered in North Dakota. The third section exams the economic impact resulting from these programs while the fourth section assesses the benefits of the program in terms of the value of equipment provided to local fire districts, and the improved safety due to reduced wildfire activity. The final section summarizes the economic gains for North Dakota from fire management programs in terms of both economic impacts and public benefits.

### **Description of Programs**

This Chapter examines key components of the fire management program including fire fighter training, firefighting equipment, and planning services throughout North Dakota. The North Dakota Forest Service is active in firefighter training. For example, the fire management program supports rural fire department personnel attendance at training provided by the National Wildfire Coordinating Group ([www.ndsu.edu/ndfs](http://www.ndsu.edu/ndfs)). The North Dakota Forest Service also coordinates approximately 35 wildland courses per year that reach 200 rural fire department personnel and 300 state agency personnel (including National Guard) annually. Another major initiative of the fire management program is its participation in the Federal Excess Personal Property and Fire Fighter Property programs of the U.S. Forest Service. These programs provide

used military and other federal government vehicles to states who then recondition and upgrade equipment and loan it to rural fire districts and guide rural fire districts with their maintenance efforts. By 2010, the fire management program of the North Dakota Forest Service had on loan hundreds of pieces of equipment worth millions of dollars to local fire districts. The fire management program also participated in forest fuel reduction programs, though the economic gains from these programs were modeled in Chapter 4.

**Economic Impact**

Table 6.1 below shows summary statistics on average annual wildfire activity in North Dakota. The table shows that there were approximately 720 wildfires per year that merited a fire department response and that these fires burned 37,800 acres ([www.ndsu.edu/ndfs](http://www.ndsu.edu/ndfs)), for an average of 52.35 acres burned per wildfire.

Table 6.1  
North Dakota Average Annual Wildfire Activity

	Wildfires	Acres Burned	Acres Burned Per Wildfire
North Dakota	720	37,800	52.35

Source: North Dakota Forest Service.

Substantial efforts are made to limit average acres burned to 52.35 and the number of fires to 720. North Dakota maintains well trained and well equipped firefighters and fire districts located throughout the state in order to reach fires in a timely manner and to fight the wildfires effectively and safely. Planning efforts reduce the number of wildfires. Further, wildfires would burn many more acres without the efforts of North Dakota firefighters or the substantial efforts to train for, plan for, and properly equip firefighters in the state.

More to the point of this study, more acres would be lost to wildfires without the efforts of the fire management program of the North Dakota Forest Service. Among other things, this program loans equipment to fire districts which allows more districts to remain open. If districts needed to finance the purchase of all of their equipment, there would be a need to consolidate fire districts, which would certainly mean longer response times. These efforts are also long-term in nature. New equipment loaned in a year is in use in the future as well. Similarly, planning for fire prevention averts a rise in acres burned both immediately and for years into the future.

How many more acres would burn without North Dakota Forest Service fire management programs? The increase is estimated in Table 6.2, in annual terms. For each program, the table shows the total estimated increase in acres burned in one year in the absence of each fire management program. In a later section, we consider the long-term reduction in fires.

Table 6.2  
Additional Acres Expected to Burn in 2010 without Fire Management Programs in North Dakota

Program	Acres Burned 2010	% Increase Without Program	Additional Acres Burned Without Program
Fire Equipment Loan	37,800	20.5%	7,762
Fire Planning Programs	37,800	1.9%	718
Total	-		8,480

Sources: North Dakota Forest Service, *Nebraska Fire Economic Analysis* and author's calculations

The first row of the Table 6.2 shows the estimated increase in acres burned if North Dakota did not make additions to its equipment loan program. There are currently 332 pieces of firefighting equipment on loan and equipment with a value of \$8.1 million in North Dakota ([www.ndsu.edu/ndfs](http://www.ndsu.edu/ndfs)). Based on data from Nebraska and Kansas, equipment loaned in the current year has a value of around 15% of the total, which would be \$1.2 million for North Dakota.

How much will new equipment loaned help reduce wildfire losses? A 1987 study (*Nebraska Fire Economics Analysis*) produced by the Nebraska Forest Service estimates that the number of acres burned per year would rise by 136.9% in the absence of programs to loan firefighting equipment. This figure is reasonably applicable to North Dakota given the similar climate and population density of non-metropolitan regions of each state. Given that 15% of equipment in the programs was donated during 2010, we estimate that 2010 program activities would have prevented a 20.5% (15% of 136.9%) increase in the number of acres burned during the year. As seen in Table 6.2, this would have amounted to another 7,762 acres burned in wildfires during 2010.

A similar analysis was conducted of Fire Management Planning Programs. These programs also were considered in the study *Nebraska Fire Economic Analysis*. That document estimated that acres burned would increase between 25% in the absence of the planning program. Reductions in acres burned in 2010, however, are the result of planning efforts in 2010 but also

in many earlier years. The immediate impact of 2010 programs therefore is substantially smaller and an annual estimate is included in row 2 of Table 6.2. The estimate is that 718 fewer acres burned during 2010 due to planning efforts. The long-term impact of 2010 fire management planning programs, which are considered later, represent the full long-term effect of 25%.

Taken together, the efforts of the fire management program reduced the acres burned by wildfires in 2010 by an estimated 8,480 acres. This naturally yields a number of benefits including higher land values, fewer injuries, and a lower likelihood that homes or other structures could be burned. These benefits will be examined in the next section. In this section, we consider the impact on annual economic activity in North Dakota. In particular, many of the wildfires that burn in North Dakota burn in agricultural lands, primarily grasslands but also on occasion in dryland crop land. By reducing the loss of agricultural acres, fire management programs help maintain grasslands for use in grazing and lesson cultivated crop losses. We estimate the retained agricultural production by looking at the average rental value of grasslands during the year, and the value of output from an acre of crop production. We estimate an average agricultural output worth \$53 per acre on this combination of grassland and crop production (most of the land is estimated to be grassland). This is the value saved per acre when the acres lost to wildfire are reduced in a year. We presume that burned acres would re-enter production in the following year. Based on this figure, North Dakota agricultural output was increased by \$412,000 in 2010 because fire management programs reduced the acres of grassland that burn each year. Table 6.3 reports the total economic impact associated with this \$412,000 direct impact for 2010.

Table 6.3  
2010 Economic Impact from the 2010 Fire Management Programs

Program Area	Direct Impact	Multiplier Impact	Total Impact
Output (Expenditures)	\$412,000	\$287,000	\$699,000
Labor Income	\$50,000	\$61,000	\$111,000
Employment	2	1	3

Source: Author's calculations

The total economic impact is \$699,000 in 2010, including \$111,000 in labor income spread over 3 jobs. This is an average income per job of \$37,000.

Table 6.4 shows the long-term economic impact from 2010 fire management programs. We assume the equipment lasts for 10 years, losing 10% of its value each year. We also utilize a 7% discount rate to estimate the present discounted value. We further consider the full, long-term

economic impact of fire management planning programs. As seen in Table 6.4, the present discounted economic impact of 2010 fire management programs was \$3,182,000. The present discounted impact of the labor income was \$506,000. This is the long-term impact from 3 jobs lasting over many years. This long-term economic impact is the full additional economic impact from fire management programs in 2010, and can be added to the economic impact estimates from Chapters 2 through 5 of this report.

Table 6.4  
Full, Long-term Economic Impact from 2010 Fire Management Programs

Program Area	Direct Impact	Multiplier Impact	Total Impact
Output (Expenditures)	\$1,876,000	\$1,306,000	\$3,182,000
Labor Income	\$225,000	\$281,000	\$506,000
Employment	2	1	3

Source: Author's calculations

Table 6.5 shows the full, long-term economic impact by industry. All results are total impacts. The largest impacts are in agriculture, the directly impacted sector. Among other sectors, the largest economic impact is in the financial services sector. The long-run impact of 2010 fire management spending was a \$268,000 on the financial services sector including \$47,000 in income. There was a \$115,000 impact over time on the wholesale trade sector.

Table 6.6 shows the state and local tax revenue impact associated with the \$3,182,000 economic impact. The long-run state and local tax revenue impact was \$185,000. About 2/5th of this impact was due to income taxes, including dividend taxes. Around 1/6 of the revenue also was due to sales taxes and 1/9 to property taxes. The remaining tax revenue was spread across a variety of employee contributions, licenses, and fees.

Beyond these economic impacts, there are also other economic gains for the North Dakota economy from fire management programs. In particular, there are gains from a reduced risk of fires. These gains are outlined below.

Table 6.5

Full, Long-Term Economic Impact from 2010 Fire Management Programs by Detailed Industry

Industry	Total Output Impact	Total Labor Income Impact	Total Employment Impact
Agriculture	\$2,359,000	\$279,000	2.1
Mining	\$0	\$0	0.0
Utilities	\$52,000	\$8,000	0.0
Construction	\$7,000	\$3,000	0.0
Manufacturing	\$93,000	\$5,000	0.0
Wholesale Trade	\$115,000	\$47,000	0.2
Retail Trade	\$27,000	\$14,000	0.1
Transportation & Warehousing	\$87,000	\$32,000	0.1
Information	\$19,000	\$4,000	0.0
Financial Services	\$268,000	\$47,000	0.4
Business Services	\$39,000	\$17,000	0.0
Education and Health Care	\$51,000	\$25,000	0.1
Recreation and Amusement	\$4,000	\$1,000	0.0
Hospitality	\$20,000	\$6,000	0.1
Other Services	\$18,000	\$9,000	0.1
Government	\$24,000	\$7,000	0.0

Source: Author's calculations Note: Totals may not sum due to rounding

Table 6.6

Full, Long-Term State and Local Tax Revenue Impact from 2010 Fire Management Programs

Type of Tax	Revenue
Dividends	\$29,000
Social Ins Tax- Employee Contribution	\$1,000
Social Ins Tax- Employer Contribution	\$2,000
Indirect Bus Tax: Sales Tax	\$31,000
Indirect Bus Tax: Property Tax	\$21,000
Indirect Bus Tax: Motor Vehicle License	\$5,000
Indirect Bus Tax: Severance Tax	\$0
Indirect Bus Tax: Other Taxes	\$9,000
Indirect Bus Tax: S/L Non-Taxes	\$20,000
Corporate Profits Tax	\$12,000
Personal Tax: Income Tax	\$41,000
Personal Tax: Non-Taxes (Fines- Fees	\$7,000
Personal Tax: Motor Vehicle License	\$4,000
Personal Tax: Property Taxes	\$0
Personal Tax: Other Tax (Fish/Hunt)	\$2,000
Total State and Local Tax	\$185,000

Source: Author's calculations.

## **Economic Benefits**

As was noted in the earlier discussion of economic impacts, 2010 fire management programs in North Dakota will yield a substantial reduction in acres burned in North Dakota during 2010. Preserving acres from fire had a substantial economic impact from increased agricultural production. There are, however, also economic benefits when fire management programs reduce the number of acres burned in North Dakota. These benefits flow from improved values for land, fewer fatalities for firefighters, and fewer homes lost to wildfires. Each type of benefit is estimated below.

### **Annual Savings**

#### *Value of Land*

The fire managements programs of the North Dakota Forest Service increased the value of agricultural production in North Dakota by an estimated \$412,000 in 2010, as was noted in the economic impact analysis. This increase in agricultural production results because more effective firefighting lowers the number of acres lost to wildfires. The increased earnings would be reflected in higher property values. The increase in property values also would be \$412,000 since property values would reflect the higher agricultural output during that year. This increase in property values due to agricultural output already was reflected as part of the economic impact. However, the increased property value would lead to a further economic benefit due to increased tax revenue, as is seen in Table. 6.7.

In North Dakota, property tax rates typically range between twenty and thirty percent of assessed value, for an average 25%. However, as noted in Chapter 4, North Dakota assessed its agricultural property at well below its market value, at 5% of market value. These two figures suggest that the effective tax rate on the market value of agricultural land is 1.25%. Multiplying this tax rate by the \$412,000 higher property values yields additional tax revenue of \$5,150 in 2010. These results are shown in Table 6.7 below.

Table 6.7  
Property Tax Revenues Saved

	Higher Property Value	Effective Tax Rate	Additional Property Tax Revenue
ND	412,000	.0125	\$5,150

*Value of Structures*

Most of the wildfires in North Dakota occur in the sparsely populated counties of the state, of the kind examined in Chapter 4. On occasion, these fires result in the loss of homes. At the same time, homes can be saved if fewer acres burn, creating a benefit value. Estimates from a Nebraska study indicate that .000027 homes are lost per acre burned in that state. As discussed in Chapter 4, Census data show that average median home value of homes of \$77,760. Multiplying that number of households expected to be lost per year by the value of a home produces an estimate of the savings from fire management programs. In North Dakota, the value of saved homes in 2010 was \$17,800. Multiplying the \$17,800 in savings by the average effective tax rate on residential real estate of 1.1% generates an estimated \$195 in savings from fire management programs.

Table 6.8  
Value of Housing Saved

	Avg. Value per House	Annual Treated Acres	Probability of a Fire Taking a House	Affected Households	Value Saved	Effective Tax Rate	Tax Saving
ND	\$77,760	8,480	0.0027%	0.23	\$17,800	.011	\$195

*Value of Lives Saved*

Research has estimated that an average of 4.5 people died per million acres of wildland fires.<sup>7</sup> This rate is included in Table 6.9. The table also shows a value of life of \$6 million. Table 6.9 below shows that when the lives lost per million acres of fire is multiplied by the acres saved from wildfire in 2010 and the value of a life, the dollar value of annual lives saved is \$228,960 in North Dakota.

Table 6.9

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<sup>7</sup> See Mason, L.C. et al. 2006. *Investments in Fuel Removals to Avoid Forest Fires Result in Substantial Benefits*. *Journal of Forestry*: 27-31.

Value of Lives Saved

	Deaths per Million Acres of Fire	Acres Treated	Value of a Life (million)	Value of Lives Saved
ND	4.5	8,480	\$6	\$228,960

*Aggregate Annual Benefits*

Table 6.10 below shows the public benefits across all categories of benefits. That aggregate annual benefit is \$252,100 per year.

Table 6.10  
Aggregate Annual Benefits of Fire Management Programs

Property Tax Revenue	Homes Saved	Property Tax Revenue	Value of Lives	Total
\$5,150	\$17,800	\$195	\$228,960	\$252,100

**Present Discounted Value of Aggregate Savings**

The annual saving from fire maintenance programs is \$252,100. This represents the value in 2010 of fire management planning and firefighting equipment loaned in that year. The impacts of equipment loans and fire planning, however, will last far more than one year. We recalculated the impacts in Tables 6.7 through 6.10 for the long-run, as was done earlier for annual economic impacts. The present value of the long-term benefits of 2010 fire management programs was an estimated \$1,147,100 as shown in Table 6.11.

Table 6.11  
Present Discounted Value of Fire Management Programs in 2010

Value from Reduced Acres Burned	Value of Training	Replacement Value of Additional Equipment Loaned	Total Benefit
\$1,147,000	\$25,000	\$1,200,000	\$2,372,000

**Other Benefits**

There are at least two other benefits from fire management programs. There is the value of the equipment loaned each year and the value of training offered. The value of the training is considered first. Specifically, we reviewed training costs in North Dakota and other nearby states such as Missouri, Colorado and Ohio, and found a savings of approximately \$50 for firefighters

receiving training in North Dakota. Given that 500 received training in a typical year, we estimate approximately \$25,000 in savings for these trainees relative to costs in other states. As training is an annual event, this annual savings is also the long-run savings, and this figure is presented in Table 6.11.

The last issue is the value of refurbished firefighting equipment newly placed on loan to rural fire districts during 2010. As was noted earlier, equipment placed in rural fire districts during the last year had an estimated replacement value of \$1.2 million. This replacement value is another major component of the annual benefits of the North Dakota Forest Service fire management program, and this benefit is included in Table 6.11. The total present discounted benefit of 2010 fire management programs is estimated to be \$2,372,000.

### **Summary**

Table 6.11 summarized the benefits of rural fire program discussed in this chapter including the benefits of training, planning, and equipment loans to rural fire districts. The total benefit from all of these sources in 2010 was \$2,372,000. In addition to these benefits, there was an economic impact from 2010 programs that lasted for years into the future. The present discounted value of this economic impact was \$3,182,000.

## Chapter 7: Community Forestry

Community forestry programs provide a variety of opportunities to enhance the quality and quantity of forests and landscapes within cities and towns of all sizes. Community forestry programs also provide a variety of benefits to a community, including: 1) raising public awareness of the value of trees; 2) recognizing the achievements of citizens, communities, groups, and businesses that work to improve community forest resources; 3) promoting sound stewardship of community forest resources; 4) and encouraging participation in other community forestry programs such as Tree City USA.

This chapter estimates economic impacts and public benefits from the community forestry program of the North Dakota Forest Service. The next section considers the economic impact of tree plantings that are facilitated by the community forestry program. The third section estimates the environmental benefits of these trees. The fourth section summarizes the impacts and benefits identified in this chapter.

### Description of Programs

The community forestry program of the North Dakota Forest Service provides a variety of services throughout the state of North Dakota. The program facilitates tree planting events, conducts community forest inventories, and provides training for landscape managers, arborists, and other professionals. The community forestry program also supports and develops a number of broad-based statewide initiatives such as Tree City USA.

### Economic Impact

The community forestry program facilitated matching grants for community tree plantings in conjunction with the North Dakota Trees Trust Fund, the U.S. Forest Service and North Dakota Department of Transportation. These programs required a 20% to 50% local match, depending on the particular program.<sup>8</sup> Therefore, the program incentivized significant

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<sup>8</sup> The North Dakota Forest Service (NDFS) in association with the North Dakota Community Forestry Council, USDA-Forest Service, North Dakota Department of Transportation and the State of North Dakota participates in community tree planting grant programs. Each program requires a match from the community in the form of cash and/or in-kind activity that is directly related to the grant project. The *Community Family Forest Grant* is funded by the North Dakota Trees Trust Fund requires a 50-50 cost share. The purpose of this grant is to honor families in the state by planting trees in communities and strengthening the tradition of annual tree planting. The maximum grant

additional expenditure beyond the expenditures of the North Dakota Forest Service. There were 2,479 trees planted through funded tree projects in 2009, the most recent year for which data was available. We assume a similar figure for fiscal year 2010, which includes portions of 2009. Taking a mean of the local match rate we assume that 35% of these tree plantings, or 870, were supported by local funds. Data from a neighboring state such as Nebraska suggests a cost of approximately \$460 per tree for tree purchase and planting. Using this figure, the 870 trees planted created a direct economic impact equal to \$400,000. Table 7.1 shows the direct and total economic impact of this \$400,000 in spending. Economic impact estimates are also presented in terms of labor income and employment. The total economic impact in fiscal year 2010 was \$558,000, including \$297,000 in labor income spread over 7 jobs.

Table 7.1  
Economic Impact from the 2010 Community Forestry Programs

Program Area	Direct Impact	Multiplier Impact	Total Impact
Output (Expenditures)	\$400,000	\$158,000	\$558,000
Labor Income	\$245,000	\$52,000	\$297,000
Employment	5	2	7

Source: Author's calculations

Table 7.2 shows the economic impacts by industry. The largest impacts are in agriculture, the directly impacted sector. Among other sectors, the largest economic impact is in the financial services sector. The impact was a \$48,000 on the financial services sector including \$6,000 in income. There was a \$29,000 impact on the education and health services sector.

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award for this tree planting grant is \$1,000. The *America the Beautiful Grant* is cosponsored by the US Forest Service and is designed to stimulate the development of innovative and effective community forestry projects. This program has a 50-50 cost share, with a maximum grant award of \$10,000. *Community Transportation Enhancement* is cosponsored by the North Dakota Department of Transportation to enhance ground-based transportation corridors. The maximum grant award is \$25,000 and has an 80-20 cost share. *Storm Tree Replacement Grant* is cosponsored by the North Dakota Department of Transportation. The purpose of the grant is to assist communities that have been affected by a natural disaster replace trees that have been lost. The program has an 80-20 cost share and a maximum grant award of \$25,000

Table 7.2  
Economic Impact from 2010 Community Forestry Programs by Detailed Industry

Industry	Total Output Impact	Total Labor Income Impact	Total Employment Impact
Agriculture	\$403,000	\$247,000	5.0
Mining	\$0	\$0	0.0
Utilities	\$7,000	\$1,000	0.0
Construction	\$2,000	\$1,000	0.0
Manufacturing	\$4,000	\$1,000	0.0
Wholesale Trade	\$11,000	\$4,000	0.1
Retail Trade	\$15,000	\$8,000	0.2
Transportation & Warehousing	\$5,000	\$2,000	0.0
Information	\$5,000	\$1,000	0.0
Financial Services	\$48,000	\$6,000	0.1
Business Services	\$8,000	\$3,000	0.0
Education and Health Care	\$29,000	\$15,000	0.3
Recreation and Amusement	\$2,000	\$1,000	0.0
Hospitality	\$8,000	\$3,000	0.2
Other Services	\$7,000	\$4,000	0.0
Government	\$5,000	\$1,000	0.0

Source: Author's calculations

Note: Totals may not sum due to rounding

Table 7.3 shows the state and local tax revenue impact associated with the economic impact. The state and local tax revenue impact was \$39,000. Nearly 1/2 of this impact was due to income taxes, even after accounting for refunds for business. Around 1/8 of the revenue also was due to both sales taxes and 1/12 to property taxes. The remaining tax revenue was spread across a variety of employee contributions, licenses, and fees.

Beyond these economic impacts, there are also other economic gains for the North Dakota economy from community forestry programs. These gains are outlined below.

Table 7.3  
State and Local Tax Revenue Impact from 2010 Community Forestry Programs

Type of Tax	Revenue
Dividends	-\$6,000
Social Ins Tax- Employee Contribution	\$0
Social Ins Tax- Employer Contribution	\$1,000
Indirect Bus Tax: Sales Tax	\$5,000
Indirect Bus Tax: Property Tax	\$3,000
Indirect Bus Tax: Motor Vehicle License	\$1,000
Indirect Bus Tax: Severance Tax	\$0
Indirect Bus Tax: Other Taxes	\$1,000
Indirect Bus Tax: S/L Non-Taxes	\$3,000
Corporate Profits Tax	-\$2,000
Personal Tax: Income Tax	\$25,000
Personal Tax: Non-Taxes (Fines- Fees	\$4,000
Personal Tax: Motor Vehicle License	\$3,000
Personal Tax: Property Taxes	\$0
Personal Tax: Other Tax (Fish/Hunt)	\$1,000
Total State and Local Tax	\$39,000

Source: Author's calculations.

## Benefits

Community forestry programs also generate public benefits by facilitating tree plantings in public spaces. These trees produce a variety of environmental and property value benefits. These benefits are estimated below. We also note that community forestry program trains arborists and other green industry professionals, and create benefits by conducting community forestry inventories, and community technical assists. However, we were not able to estimate these benefits.

### *Programs to Facilitate Community Tree Planting Projects*

As noted earlier, the community forestry program has facilitated programs that incentivized the planting of 2,479 trees as part of public tree plantings in 2009. These trees provide a number of benefits. In particular, the Center for Urban Forest Research published a

2003 report on the benefits of trees planted in our region.<sup>9</sup> The benefits include but are not limited to:

- Reducing atmospheric carbon dioxide
- Improving air quality
- Reducing stormwater runoff and hydrology
- Enhancing esthetic value

McPherson et al. value “public” trees (trees planted on public land) over a 40-year planning horizon. They measure the benefit derived from the categories described above as well as the costs of maintaining trees over their lives. Their measures also account for losses in newly planted trees. The study provides estimates for large, medium and small deciduous species as well as conifers. Their Appendix A shows initial planting costs, other costs and benefits in 5-year increments from year five through year 40.

Benefits and costs for large deciduous trees are estimated for each year by linearly extrapolating the 5-year incremental data. Costs are subtracted from benefits to get the net benefit in each year. Using a three percent inflation rate and a five percent discount rate, present discounted values are calculated in each year. For example, the present discounted value of the net benefits that flow over 40 years from a small tree is equal to \$14. The present discounted value of the net benefits that flow over 40 years from a conifer is equal to \$326.

Table 7.4  
40 Present Discounted Value of a Tree

Small Deciduous	\$14
Medium Deciduous	\$280
Large Deciduous	\$573
Conifer	\$326

Table 7.5 below shows the distribution by category of the 2,479 trees planted in North Dakota by incentivized public tree plantings during 2009. The most common type of planting was small deciduous trees, closely followed by large deciduous trees. .

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<sup>9</sup> McPherson, E. G. et al. (2003). *Northern Mountain and Prairie Community Tree Guide: Benefits, Costs and Strategic Planting*. Davis, CA: Center for Urban Forest Research, USDA Forest Service, Pacific Southwest Research Station.

Table 7.5  
Number of Trees Planted by Category

Small Deciduous	870
Medium Deciduous	495
Large Deciduous	867
Conifer	247

Multiplying the present discounted value of the 40-year flow of benefits per tree from Table 7.4 above by the number of trees planted in a year in Table 7.5 generates the present discounted value of the 40-year flow of net benefits that flow from all trees planted in one year. The annual net benefits by type of tree are shown in Table 7.6 below. For example, the planting of 870 small deciduous trees generated \$12,180 in net benefit. The planting of 867 large deciduous trees generated \$496,791 in net benefit. Aggregating all of these figures, the present discounted value of net benefits that flow over 40 years from annual tree plantings is \$728,000.

Table 7.6  
Present Discounted Value of Net Benefit  
from Trees Planted

Small Deciduous	\$12,180
Medium Deciduous	\$138,600
Large Deciduous	\$496,791
Conifer	\$80,522
Total	\$728,093

**Summary**

This chapter estimated the economic impact and public benefits flowing from the community forest program of the North Dakota Forest Service. The findings were that in fiscal year 2010 the community forestry program generated an economic impact of \$558,000 and also yielded benefits of \$728,000. These public benefits and economic impacts should be added towards the total reported for the North Dakota Forest Service in the final chapter of this report.

## Chapter 8: Conservation Tree Planting

The North Dakota Forest Service encourages tree planting through tree sales and the operation of the Towner State Nursery. The Towner State Nursery produces over a million trees annually and generates substantial sales. This chapter assesses the economic impact from these tree sales.

### Description of Programs

The North Dakota Forest Service's Towner State Nursery distributes seedlings for conservation tree plantings as part of an effort to promote vital forest resources. The resulting planting activity creates shelterbelts, living snow fences and other tree plantings to benefit conservation. The scope of activities is substantial. For example, 1.2 million trees are produced annually and in fiscal year 2010 the nursery had tree sales of \$499,000.

### Economic Impact

Production and sale of seedlings for planting generates an economic impact. This economic impact is reported in Table 8.1. The direct economic impact is the annual tree sales of \$499,000. Table 8.1 also provides estimates of the total economic impact, and the labor market impacts in terms of labor income and employment. The total economic impact was \$918,000 in fiscal year 2010 including \$543,000 in labor income spread over 11 wage and salary jobs. As noted earlier, this additional economic impact can be added to the economic impact estimates from earlier chapters of this report.

Table 8.1  
Economic Impact from Conservation Tree Planting Programs

Program Area	Direct Impact	Multiplier Impact	Total Impact
Output (Expenditures)	\$499,000	\$419,000	\$918,000
Labor Income	\$315,000	\$228,000	\$543,000
Employment	7	4	11

Source: Author's calculations.

Note: Columns may not sum to totals due to rounding.

Table 8.2 shows the total economic impacts by industry. The largest impact is in government, the directly impacted sector, given that the Towner State Nursery is operated by the North Dakota Forest Service. Among other sectors, the largest economic impact is in the financial services sector. There was a \$108,000 impact on the financial services sector including \$17,000 in income. There was a \$41,000 impact on the health care and education sector.

Table 8.3 shows the state and local tax revenue impact associated with the \$918,000 economic impact. The total state and local tax revenue impact was \$47,000. Nearly the entire impact is due to income taxes, including dividends. There is negative impact in certain indirect business taxes, since the nursery is a government-owned enterprise. The remaining tax revenue was spread across a variety of employee contributions, licenses, and fees.

Table 8.2

## 2010 Economic Impact from Conservation Tree Planting Programs by Detailed Industry

Industry	Total Output Impact	Total Labor Income Impact	Total Employment Impact
Agriculture	\$1,000	\$0	0.0
Mining	\$1,000	\$1,000	0.0
Utilities	\$25,000	\$3,000	0.0
Construction	\$34,000	\$15,000	0.3
Manufacturing	\$14,000	\$3,000	0.0
Wholesale Trade	\$23,000	\$9,000	0.1
Retail Trade	\$21,000	\$11,000	0.3
Transportation & Warehousing	\$18,000	\$7,000	0.1
Information	\$13,000	\$3,000	0.0
Financial Services	\$108,000	\$17,000	0.5
Business Services	\$59,000	\$28,000	0.6
Education and Health Care	\$41,000	\$20,000	0.3
Recreation and Amusement	\$3,000	\$1,000	0.0
Hospitality	\$14,000	\$5,000	0.3
Other Services	\$14,000	\$7,000	0.1
Government	\$527,000	\$307,000	7.1

Source: Author's calculations. Note: Totals may not sum due to rounding

Table 8.3

## 2010 State and Local Tax Revenue Impact from Conservation Tree Planting Programs

Type of Tax	Revenue
Dividends	\$11,000
Social Ins Tax- Employee Contribution	\$1,000
Social Ins Tax- Employer Contribution	\$3,000
Indirect Bus Tax: Sales Tax	-\$6,000
Indirect Bus Tax: Property Tax	-\$4,000
Indirect Bus Tax: Motor Vehicle License	-\$1,000
Indirect Bus Tax: Severance Tax	\$0
Indirect Bus Tax: Other Taxes	-\$2,000
Indirect Bus Tax: S/L Non-Taxes	-\$4,000
Corporate Profits Tax	\$5,000
Personal Tax: Income Tax	\$33,000
Personal Tax: Non-Taxes (Fines- Fees	\$6,000
Personal Tax: Motor Vehicle License	\$3,000
Personal Tax: Property Taxes	\$0
Personal Tax: Other Tax (Fish/Hunt)	\$1,000
Total State and Local Tax	\$47,000

Source: Author's calculations.

## Chapter 9: Summary

This study examined annual economic impacts and public benefits due to the programs of the North Dakota Forest Service during fiscal year 2010. Economic impacts refer to additional economic activity in the state flowing from the programs of the NDFS. Public benefits refer to safety benefits, cost savings for rural fire departments, and reduced costs for training. We examined the economic gains from operations and pass-through spending, fire management programs, rural forestry and forest health programs, community forestry programs, and conservation tree planting. The total present value of public benefits from North Dakota Forest Service programs in 2010 was \$3,330,000.

The total economic impact from North Dakota Forest Service programs in 2010 was \$15,798,000, as is seen in Table 9.1. This impact included \$8,407,000 of labor income (wages, salaries, and benefits) spread over 188 jobs

Table 9.1  
Combined Economic Impact of 2010 North Dakota Forest Service Programs

Program Area	Direct Impact	Multiplier Impact	Total Impact
Output (Expenditures)	\$10,236,000	\$5,562,000	\$15,798,000
Labor Income	\$6,304,000	\$2,103,000	\$8,407,000
Employment	145	43	188

Source: Author's calculations.

Table 9.2 shows the total economic impacts by industry. The largest impacts are in agriculture (which includes forestry) and government, the directly impacted sectors. Among other sectors, the largest economic impact is in the financial services sector. There was a \$1,552,000 impact on the financial services sector including \$217,000 in income. There was a \$753,000 impact on the education and health care sector and a \$741,000 impact on the recreation and amusement sector.

As seen in Table 9.3, there was also an associated state and local tax revenue impact of \$1,262,000.

Table 9.2

## Combined Economic Impact of 2010 North Dakota Forest Service Programs, Detailed Industry

Industry	Total Output Impact	Total Labor Income Impact	Total Employment Impact
Agriculture	\$5,414,000	\$2,097,000	52
Mining	\$3,000	\$1,000	0
Utilities	\$194,000	\$29,000	0
Construction	\$79,000	\$33,000	1
Manufacturing	\$269,000	\$27,000	0
Wholesale Trade	\$373,000	\$152,000	2
Retail Trade	\$410,000	\$220,000	8
Transportation & Warehousing	\$209,000	\$79,000	1
Information	\$184,000	\$42,000	0
Financial Services	\$1,522,000	\$217,000	5
Business Services	\$868,000	\$330,000	15
Education and Health Care	\$753,000	\$375,000	8
Recreation and Amusement	\$741,000	\$287,000	15
Hospitality	\$240,000	\$79,000	4
Other Services	\$217,000	\$109,000	3
Government	\$4,323,000	\$3,496,000	68

Source: Author's calculations Note: Totals may not sum due to rounding

Table 9.3

## Combined 2010 State and Local Tax Revenue Impact of North Dakota Forest Service Programs

Type of Tax	Revenue
Dividends	\$149,000
Social Ins Tax- Employee Contribution	\$14,000
Social Ins Tax- Employer Contribution	\$34,000
Indirect Bus Tax: Sales Tax	\$144,000
Indirect Bus Tax: Property Tax	\$110,000
Indirect Bus Tax: Motor Vehicle License	\$19,000
Indirect Bus Tax: Severance Tax	\$1,000
Indirect Bus Tax: Other Taxes	\$34,000
Indirect Bus Tax: S/L Non-Taxes	\$73,000
Corporate Profits Tax	\$65,000
Personal Tax: Income Tax	\$464,000
Personal Tax: Non-Taxes (Fines- Fees	\$86,000
Personal Tax: Motor Vehicle License	\$47,000
Personal Tax: Property Taxes	\$3,000
Personal Tax: Other Tax (Fish/Hunt)	\$20,000
Total State and Local Tax	\$1,262,000

Source: Author's calculations.