1999 HOUSE AGRICULTURE

HB 1040

1999 HOUSE STANDING COMMITTEE MINUTES

BILL/RESOLUTION NO. HB 1040

House Agriculture Committee

❑ Conference Committee

Hearing Date 1-21-99

Tape Number	Side A	Side B	Meter #
ONE- HB1040	x		0-55
		x	0.03
Committee Clerk Signature Arlin Hanson			

Minutes:

Summary of bill: Relating to a statewide hail suppression pilot program by the atmospheric resource board and relating to hail suppression license and permit requirements:

Jennifer Clark: ND Legislative Council.

Briefly HB 1040 provides for a 6 year suppression pilot program. This bill changes present law in that it allows it to be statewide wheras original law provides for county wide vote before put into effect.

Rep Herbel: Is this required of all counties?

Ms Clark: If I understand your question is it like the present program? No the present one allows counties to choose wither they participate or not. This one would be mandatory,

Rep Koppang: Ms Clark, the 3.1 million is that just for the 1999-2000 biennium? Do you have any dollar amount for succeeding biennium's or not?

Ms. Clark: I do not have those numbers with me but do know of individuals who have them.

Rep Nowatzki: If this goes in place do the 5 counties already with Hail suppression programs get left out?

Ms Clark: No, those five counties could rely solely on the state program or just supplement it with their own program.

Rep ***David Drovdahl***: Dist 39 As we watch with dismay the plight of our farm economy, this is but an investment in our farmers. Hail suppression has a track record of success; it does return dollars into the economy. We have sufficient data to verify that. Secondly it also helps the property owners in less damages to homes, cars, etc. Some say we shouldn't mess with Mother Nature. This guy probably used chemicals, fertilizer, etc.. (Testimony attached).

Rep Berg: If we do fund this program who ultimately is paying for the program(3.1 mill per year). Would the Insurance Companies step forward?

Drovdahl: Rep Cost of 3.1 million to the tax payer, but increased sale tax collections, and *income tax as projected by the study should more than cover the cost of the project.*

Bruce Boe: Director of the Atmospheric Resource Board. In North America, hail suppression technology is presently being applied in North Dakota, Kansas, Oklahoma, and Alberta, Canada. While the American programs are all driven primarily by agriculture (crop-hail reduction) interests. Evaluations based upon crop-hail insurance data indicate significant reduction in damage; 45% in North Dakota, and 27% in Kansas. The Oklahoma and Alberta operations are too new to be evaluated in a meaningful way. (Testimony attached).

Darren Langerud: Chief Meteorologist, ARB. (Testimony attached) The planning stage would include a provision for an environmental impact study to address the concerns of that nature and would include acquiring a permit from Montana, South Dakota, and maybe Canada for cloud seeding in a buffer zone which is adjacent to North Dakota. Would include a process to hear local delegates concerns and address them to their satisfaction.

Chairman Nicholas: What's in the Gov budget for weather mod?

Mr Langerud: Basically status que. Non of this money is in Gov budget.

Rep Warner: How fast can you zero in on a storm cloud?

Mr Langerud: Hard to tell but have seen where 30 mins after seeding a cloud you can see the results.

Wayne Mrnak: Rancher in Bowman County where we have hail suppression program now.

Rep Brusegaard: If you have less hail loss to you buy less hail insurance?

Mr Mrnak: We carry no hail insurance on our ranch.

Rep Warner: Ward County, farmer, carries no hail insurance since program put in place.

Opposition: ***Farmer from Slope County*** opposed to bill, next to the Montana border and the program dries them out. No hail but no rain either so doesn't help them. Haven't cut hay for two years there.

Mike Dwyer: Water Resource Board supports HB 1040 completely. He's personally from the Western country and knows what the benefits are from the program.

Kent Olson: Ex Dir of Professional Insurance Assoc. Insurance business we try to reduce risk and this program reduces risk. For this reason we support the bill.

North Dakota has a very low Home owners rates but high in Crop damages. Hail losses are very high in ND.

Chairman Nicholas: Seeing as how you are in favor of this bill and that it will reduce the risk factor would your Insurance companies be willing to pick up the costs (3.2 million) for the project.

Kent Olson: Basically no. We are in the business of making a profit and with the losses that have occurred in the past years we are just hoping the risk factor is lessened. No drop in home owners insurance but they have leveled off.

Rep Stefonowicz; Have the crop Insurance rates dropped any where they have weather mod.?

Kent Olson: Ins companies could answer that question better then I.

Dan----------Marmon, Nd: Opposed to bill because it hurts them. They voted it out in their county. If it's such a wonderful program why did the farmers vote it out?

Farmer from Slope County: They live next to the Montana Border and it hurts them as cuts back on their rain fall. They have been dry last few years since program went to operations.

Committee action 1-21-99

Motion by Rep Brusegaard DO NOT PASS second by Rep Koppang

yes 12 no 2 absent 1

Carrier: Rep Brusegaard

FISCAL NOTE

(Return original and 10 copies)

Bill/Resolution No.: _____ Amendment to: HB 1040

Requested by Legislative Council Date of Request: 2-10-99

1. Please estimate the fiscal impact (in dollar amounts) of the above measure for state general or special funds, counties, cities, and school districts.

Narrative: As amended, this bill authorizes the Atmospheric Resource Board to study and plan a statewide hail suppression program with such funds as might be available within the agency's existing appropriation or from private sources. There are no additional monies appropriated for such purpose in the 1999-2001 biennium. Statewide program benefits from decreased hail damage and additional rainfall are projected to total $267M annually in increased business activity, which will generate an estimated additional $5.1M in general fund revenue annually, according to an economic study of the project for the period of 1988-1997, authored by F.L. Leistritz and R. Sell, both of the NDSU Department of Agricultural Economics. A copy of the executive summary of the study is attached to this fiscal note, complete copies are available upon request.

The amendments to HB-1040 also clarify the ability of privately-funded entities to participate in the existing cloud modification program. Atmospheric Resource Board counsel has reviewed existing law and legislative history, and finds it consistent with this amendment, but feels the amendments drafted by Legislative Counsel clarify how such participation is to be handled.

2. **State** fiscal effect in dollar amounts:

	1997-99 Biennium		1999-2001 Biennium		2001-03 Biennium	
	General Fund	Special Funds	General Fund	Special Funds	General Fund	Special Funds
Revenues:	0	0	0	0	0	0
Expenditures:	0	0	0	0	0	0

3. What, if any, is the effect of this measure on the appropriation for your agency or department:
   a. For rest of 1997-99 biennium: none
   b. For the 1999-2001 biennium: No effect projected.
   c. For the 2001-03 biennium: No effect projected.

4. **County, City, and School District** fiscal effect in dollar amounts:

1997-99 Biennium			1999-2001 Biennium			2001-03 Biennium		
Counties	Cities	School Districts	Counties	Cities	School Districts	Counties	Cities	School Districts
0	0	0						

There will be no cost to cities, counties, or school districts in following bienniums. However, should funds become available and operations expanded, additional business activity would result from decreased hail crop and property losses and increased production.

If additional space is needed, attach a supplemental sheet.

Signed Bruce A. Boe

Typed Name Bruce A. Boe, Director

Date Prepared: 02 - 11- 1999

Department Atmospheric Resource Board

Phone Number 8 - 2788

HIGHLIGHTS

North Dakota producers experience substantial losses to farm output and fixed assets because of hail. The North Dakota Cloud Modification Project (NDCMP) has actively practiced cloud modification in five or six counties in western North Dakota during the past 10 years. A recent study concluded that crop-hail damage in the cloud modification counties was reduced by 45 percent for the wheat, barley, oats, corn, sunflower, and flax. Another impact of the cloud modification project is enhanced rainfall. Enhanced rainfall does not always benefit all producers, depending on the subsequent impacts on yield, quality, and price. The economic impact to the state of enhanced rainfall is also estimated. The crops used in estimating the combined impacts of hail reduction and rainfall enhancement were wheat, barley, oats, sunflower, corn, flax, soybeans, and dry edible beans.

Estimates of crop-hail losses and crop losses prevented with cloud modification for all counties were based upon crop production and hail data from 1988 to 1997. These estimates required multiplying the county level gross values of production by its annual loss-cost ratio to get the expected hail loss and then multiplying the expected loss by the 45 percent reduction factor to estimate the crop output savable with cloud modification. Slightly different equations were necessary depending on whether the county had an on-going cloud modification project in place.

Changes in crop production due to increased rainfall were determined. The effects of increased wheat production on price received were considered. A change in crop production was estimated by changing yields per acre, not acres of crop harvested.

The direct impact of hail reduction was $34 million and the direct impact of rainfall enhancement was $52 million statewide, which resulted in a total direct impact of nearly $87 million annually. This direct impact results in an increase in total business activity of $267 million or an average $14.52 per planted acre. Seventy-five percent of the total economic impact occurred in two sectors of the economy, 'households' and 'retail trade.' Pembina County is projected to experience a slight negative impact from the additional rainfall (-$0.28 per planted acre), but this is more than offset by the projected benefits from hail suppression activities (+$3.05 per planted acre). All other counties are expected to be positive in both categories. Total impacts were generally greater in the eastern one-half of North Dakota while the impacts as a percentage of gross receipts were greater in western North Dakota.

The estimated annual cost of operating the NDCMP statewide was $3.2 million. Increased state tax revenue from sales and use tax, personal income tax, and corporate income tax as a result of the program was $5.1 million annually. Thus, the increased state tax revenue would substantially exceed the cost of the program.

FISCAL NOTE

DEC 31 1998

(Return original and 10 copies)

Bill/Resolution No.: HB 1040 Amendment to: _____

Requested by Legislative Council Date of Request: December 23, 1998

1. Please estimate the fiscal impact (in dollar amounts) of the above measure for state general or special funds, counties, cities, and school districts.

Narrative: This bill proposes a statewide hail suppression program, at a cost of $3.1M from the general fund in the 1999-2001 biennium. Of this, $0.4M is to be expended during the first year for project design, planning, and environmental assessments. The annual cost of hail suppression operations in the second year of the biennium is $2.7M. The program benefits are projected to total $267M annually in increased business activity, which will generate an estimated additional $5.1M in general fund revenue annually, according to an economic study of the project for the period of 1988-1997. This study used the 45% reduction in crop-hail damage reported in the *Journal of Applied Meteorology* (1997), and estimated increased rainfall on the order of 15%, as reported in NDSU Agricultural Economics Report No. 172 (1983). Only wheat, barley, sunflowers, soybeans, oats, corn grain, dry edible beans, and flax were included; other crops, including a forage crops, would realize additional benefits. Likewise, no estimate is made of benefits resulting from reduced property damage. The economic study was authored by F.L. Leistritz and R. Sell, both of the NDSU Department of Agricultural Economics. A copy of the executive summary of the study is attached to this fiscal note, complete copies are available upon request.

2. **State** fiscal effect in dollar amounts:

	1997-99 Biennium		1999-2001 Biennium		2001-03 Biennium	
	General Fund	Special Funds	General Fund	Special Funds	General Fund	Special Funds
Revenues:	0	0	E $5.1M	see item 4	E $10.2M	see item 4
Expenditures:	0	0	$3.1M	0	$5.72M	0

3. What, if any, is the effect of this measure on the appropriation for your agency or department:
   a. For rest of 1997-99 biennium: none
   b. For the 1999-2001 biennium: increase of $3.1M (general fund) over Governor's (1999-2001) recommendation
   c. For the 2001-03 biennium: increase of $5.72M (general fund) over Governor's (1999-2001) recommendation, only inflationary adjustments required for following biennium

4. **County, City, and School District** fiscal effect in dollar amounts:

1997-99 Biennium			1999-2001 Biennium			2001-03 Biennium		
Counties	Cities	School Districts	Counties	Cities	School Districts	Counties	Cities	School Districts
0	0	0	There will be no cost to cities, counties, or school districts in following bienniums, but projected additional business activity resulting from decreased hail crop and property losses and increased production should generate additional local tax revenue. Quantification of the magnitude of the additional revenue have not been attempted.					

If additional space is needed, attach a supplemental sheet.

Signed Bruce A. Boe

Typed Name Bruce A. Boe, Director

Date Prepared: 12 - 31 - 1998

Department Atmospheric Resource Board

Phone Number 8 - 2788

Economic Impact of Reducing Hail and Enhancing Rainfall in North Dakota
December 1998

Randall S. Sell and F. Larry Leistritz

HIGHLIGHTS

North Dakota producers experience substantial losses to farm output and fixed assets because of hail. The North Dakota Cloud Modification Project (NDCMP) has actively practiced cloud modification in five or six counties in western North Dakota during the past 10 years. A recent study concluded that crop-hail damage in the cloud modification counties was reduced by 45 percent for the wheat, barley, oats, corn, sunflower, and flax. Another impact of the cloud modification project is enhanced rainfall. Enhanced rainfall does not always benefit all producers, depending on the subsequent impacts on yield, quality, and price. The economic impact to the state of enhanced rainfall is also estimated. The crops used in estimating the combined impacts of hail reduction and rainfall enhancement were wheat, barley, oats, sunflower, corn, flax, soybeans, and dry edible beans.

Estimates of crop-hail losses and crop losses prevented with cloud modification for all counties were based upon crop production and hail data from 1988 to 1997. These estimates required multiplying the county level gross values of production by its annual loss-cost ratio to get the expected hail loss and then multiplying the expected loss by the 45 percent reduction factor to estimate the crop output savable with cloud modification. Slightly different equations were necessary depending on whether the county had an on-going cloud modification project in place.

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The estimated annual cost of operating the NDCMP statewide was $3.2 million. Increased state tax revenue from sales and use tax, personal income tax, and corporate income tax as a result of the program was $5.1 million annually. Thus, the increased state tax revenue would substantially exceed the cost of the program.

Date: 1-21-99
Roll Call Vote #: 1

1999 HOUSE STANDING COMMITTEE ROLL CALL VOTES
BILL/RESOLUTION NO. 1040

House Agriculture Committee

☐ Subcommittee on _____
or
☐ Conference Committee

Legislative Council Amendment Number _____

Action Taken Do not pass Reconsidered

Motion Made By Brusegaard Seconded By Koppang

Representatives	Yes	No	Representatives	Yes	No
Eugene Nicholas, Chaiman	✓		Bob Stefonowicz		✓
Dennis E. Johnson, Vice Chm	✓				
Thomas T. Brusegaard	✓		✓		
Earl Rennerfeldt	✓				
Chet Pollert	✓		✓		
Dennis J. Renner	✓				
Michael D. Brandenburg	✓		✓		
Gil Herbel	✓		✓		
Rick Berg	✓				
Myron Koppang	✓				
John M. Warner	✓	✓			
Rod Forelich	✓				
Robert E. Nowatzki	✓		✓		
Phillip Mueller	✓				

Total (Yes) 12 No 2

Absent 1

Floor Assignment Rep Brusegaard

If the vote is on an amendment, briefly indicate intent:

REPORT OF STANDING COMMITTEE

HB 1040: Agriculture Committee (Rep. Nicholas, Chairman) recommends **DO NOT PASS** (12 YEAS, 2 NAYS, 1 ABSENT AND NOT VOTING). HB 1040 was placed on the Eleventh order on the calendar.

90156.0201
Title. 0300

Prepared by the Legislative Council staff for
Representative Nicholas
February 1, 1999

PROPOSED AMENDMENTS TO HOUSE BILL NO. 1040

Page 1, line 1, replace "create and enact a new section to chapter 61-04.1" with "amend and reenact sections 61-04.1-03, 61-04.1-08, 61-04.1-09, 61-04.1-20, 61-04.1-21, 61-04.1-38, and 61-04.1-39"

Page 1, line 2, remove "a statewide" and replace "program" with "operations"

Page 1, line 3, remove "to amend and reenact section 61-04.1-12 of the North Dakota Century Code,"

Page 1, line 4, remove "relating to hail suppression license and permit requirements; to provide an appropriation;"

Page 1, line 5, replace "provide an expiration date" with "repeal section 61-04.1-03.1 of the North Dakota Century Code, relating to the transition from the weather modification board to the atmospheric resource board"

Page 1, line 7, replace "61-04.1-12" with "61-04.1-03"

Page 1, after line 8, replace the remainder of the bill with:

"**61-04.1-03. Definitions.** As used ~~herein~~ in this chapter, unless the context ~~or subject matter~~ otherwise requires:

1. "Board" means the North Dakota atmospheric resource board which, in the exercise of the powers granted ~~herein~~ under this chapter, ~~shall have~~ has all of the powers of an administrative agency as defined in chapter 28-32.

2. "Controller" refers to any licensee duly authorized in this state to engage in weather modification activities.

3. "Geographical region" means a geographical area with a contiguous boundary that may enclose a portion of any county or counties.

4. "Hail suppression" refers to the activation of any process ~~which~~ that will reduce, modify, suppress, eliminate, or soften hail formed in clouds or storms.

~~4.~~ 5. "Increasing precipitation" refers to the activation of any process ~~which~~ that will actually result in greater amounts of moisture reaching the ground in any area from a cloud or cloud system than would have occurred naturally.

~~5.~~ 6. "Initiating precipitation" refers to the process of causing precipitation from clouds ~~that~~ which could not otherwise have occurred naturally or inducing precipitation significantly earlier than would have occurred naturally.

~~6.~~ 7. "Operation" means the performance of any weather modification activity undertaken for the purpose of producing or attempting to produce any form of modifying effect upon the weather within a limited geographical area or within a limited period of time.

~~7.~~ 8. "Research and development" means exploration, field experimentation, and extension of investigative findings and theories of a scientific or

technical nature into practical application for experimental and demonstration purposes, including the experimental production of models, devices, equipment, materials, and processes.

~~8.~~ 9. "Weather modification" means and extends to the control, alteration, and amelioration of weather elements including man-caused changes in the natural precipitation process, hail suppression or modification, and alteration of other weather phenomena including clouds, temperature, wind direction, and velocity, and the initiating, increasing, decreasing, and otherwise modifying by artificial methods of precipitation in the form of rain, snow, hail, mist, or fog through cloud seeding, electrification, or by other means to provide immediate practical benefits.

SECTION 2. AMENDMENT. Section 61-04.1-08 of the North Dakota Century Code is amended and reenacted as follows:

61-04.1-08. Powers and duties of board. The board ~~may exercise~~ has the following powers and ~~shall have the following~~ duties:

1. The board shall appoint an executive director to serve at ~~its~~ the board's discretion~~,~~ and to perform ~~such~~ duties ~~as~~ assigned by the board.

2. The board shall authorize the employment of ~~whatever~~ staff ~~it~~ the board deems necessary to carry out the provisions of this chapter. The executive director shall hire the staff, subject to the approval of the board.

3. The board shall adopt rules concerning qualifications, procedures, and conditions for issuance, revocation, suspension, and modification of licenses and permits; standards and instructions governing weather modification operations, including monitoring and evaluation; recordkeeping and reporting, and the board shall establish procedures and forms for ~~such~~ this recordkeeping and reporting. The board may adopt all other rules necessary to the administration of this chapter. The provisions of chapter 28-32 ~~shall~~ apply to this chapter~~,~~ and rules of the board ~~shall~~ must be published in the North Dakota Administrative Code.

4. The board may contract with any person, ~~association, partnership, corporation, or limited liability company, with the federal government, and with any county or groups of counties,~~ as provided in section 61-04.1-20, to carry out weather modification operations and ~~shall~~, in connection with regulated weather modification operations in a county or geographical region, shall carry on monitoring and evaluation activities.

5. The board may order any person who is conducting weather modification operations in violation of this chapter~~,~~ or any rules adopted ~~pursuant~~ to ~~it~~ implement this chapter, to cease and desist from ~~such~~ those operations and the order ~~shall be~~ is enforceable in any court of competent jurisdiction within this state.

6. The board may cooperate and contract with any ~~private~~ person ~~or any local, state, or national commission, organization, or agency~~ engaged in activities similar to the work of the board and may make contracts and agreements to carry out programs consistent with the purpose and intent of this chapter. The board may ~~also, in accordance with law,~~ request and accept any grants of funds or services from any ~~such commission, organization,~~ person~~, or agency,~~ and expend ~~such~~ these funds or use ~~such~~ these services to carry out ~~the provisions of~~ this chapter.

7. The board shall monitor the current state of knowledge regarding the magnitude and impacts of possible regional and global climatic changes

and shall provide ~~such~~ information to other state agencies that may benefit from ~~such~~ this knowledge.

8. The board shall administer and enforce the provisions of this chapter and do all things reasonably necessary to effectuate the purposes of this chapter.

9. The board may plan and study a hail suppression pilot program that would provide urban and rural hail suppression operations statewide or to any portion of the state.

SECTION 3. AMENDMENT. Section 61-04.1-09 of the North Dakota Century Code is amended and reenacted as follows:

61-04.1-09. Board to establish research and development program - Hail suppression pilot program.

1. The board shall establish a program of weather modification research and development in this state. The board shall supervise and coordinate all research and development activities in the state or research and development activities outside of the state participated in or conducted by any state institution or state or county agency.

2. If the board plans and studies a hail suppression pilot program, the board may conduct a planning phase that includes studying the impact on the environment, providing public education, and formulating an operations plan.

SECTION 4. AMENDMENT. Section 61-04.1-20 of the North Dakota Century Code is amended and reenacted as follows:

61-04.1-20. Board may create operating districts - Representation of noncontracting counties. The board ~~shall have the authority to~~ may place any county ~~contracting~~ or geographical region for which a person contracts with the state for weather modification operations~~,~~ in ~~such an~~ any operational district ~~as~~ the board ~~shall deem~~ determines necessary to best provide ~~such~~ that county or geographical region with the benefits of weather modification. In determining the boundaries of ~~such~~ an operating ~~districts~~ district, the board shall consider the patterns of crops within the state, climatic patterns, and the limitations of aircraft and other technical equipment. The board may assign any county ~~which~~ that has not created a weather modification authority under this chapter to an operating district solely for the purpose of representation on the operations committee of ~~such~~ that district.

SECTION 5. AMENDMENT. Section 61-04.1-21 of the North Dakota Century Code is amended and reenacted as follows:

61-04.1-21. District operations advisory committees created - Duties.

1. There ~~shall~~ must be a district operations advisory committee in each operations district created in accordance with section 61-04.1-20. Each committee ~~shall~~ must be composed of one commissioner of the weather modification authority from each county within ~~such~~ the district, a representative of each geographical region assigned to the district under section 61-04.1-20, and one member of the board of county commissioners from ~~the~~ each county ~~or counties~~ assigned to the district ~~in accordance with~~ under section 61-04.1-20. Each advisory committee ~~shall~~, upon majority vote, with the concurrence of the board, ~~prescribe~~ shall adopt rules and bylaws necessary to govern ~~its~~ that committee's procedures and meetings. Each committee shall evaluate weather modification operations

within ~~its respective~~ that committee's district and make recommendations and proposals to the board concerning ~~such~~ these operations.

2. The weather modification authority of any county authorized to contract for weather modification operations under this chapter ~~and~~ which is not assigned to an operations district~~,~~ shall assume the functions of the district operations committee and ~~shall have and~~ may exercise the powers and duties assigned to the operations committees by this chapter and by the rules of the board.

SECTION 6. AMENDMENT. Section 61-04.1-38 of the North Dakota Century Code is amended and reenacted as follows:

61-04.1-38. Board may receive and expend funds. The board ~~is hereby authorized to~~ may receive and accept in the name of the state any ~~and all~~ funds ~~which may be~~ that are offered or become available from any federal ~~grants~~ grant or ~~appropriations~~ appropriation, private ~~gifts~~ gift, ~~donations~~ donation, or ~~bequests~~ bequest, county funds, or funds from any other source~~,~~ except license and permit fees, and to expend ~~said~~ these funds for the expense of administering this chapter, and, with the exception of county funds, for the encouragement of research and development in weather modification by any private person, the North Dakota state university, the university of North Dakota, or any other appropriate state, county, or public agency in this state ~~either~~ by direct grant, ~~by~~ contract, or ~~by~~ other means.

All federal grants, federal appropriations, private gifts, donations, or bequests, county funds, or funds from any other source~~,~~ except license and permit fees, received by the board ~~shall~~ must be paid over to the state treasurer, who shall credit ~~same~~ this amount to a special fund in the state treasury known as the "state weather modification fund". All proceeds deposited by the state treasurer in the state weather modification fund are hereby appropriated to the board and ~~shall~~, if expended, must be disbursed by warrant-check prepared by the office of management and budget upon vouchers submitted by the board~~,~~ and ~~shall~~ must be used for the purpose of paying for the expense of administration of this chapter and, with the exception of county funds, for the encouragement of research and development in weather modification by any private person, the North Dakota state university, the university of North Dakota, or any other appropriate state, county, or public agency by direct grant, ~~by~~ contract, or ~~by~~ other means.

SECTION 7. AMENDMENT. Section 61-04.1-39 of the North Dakota Century Code is amended and reenacted as follows:

61-04.1-39. County appropriations - State to provide funds. Any county weather modification authority ~~which has~~ that contracted with the board for weather modification operations under this chapter shall appropriate to the state weather modification fund ~~such~~ the amount ~~as is~~ determined by the board to be necessary to provide ~~such~~ that county with weather modification operations. The board may expend, from the state weather modification fund, ~~such~~ the funds ~~as it~~ the board deems necessary to provide a contracting ~~counties~~ county or geographical region with weather modification operations.

SECTION 8. REPEAL. Section 61-04.1-03.1 of the North Dakota Century Code is repealed."

Renumber accordingly

Please type or use black pen to complete

Date 2-4

Roll call vote # 2

DO NOT USE HIGHLIGHTER ON ANY FORMS

1999 HOUSE STANDING COMMITTEE ROLL CALL VOTES

BILL/RESOLUTION NO. 1040

House Agriculture Committee Committee

☐ Subcommittee on _____

☐ Conference Committee

} Identify or check where appropriate

Legislative Council Amendment Number 90156:0201

Action Taken Reconsider Do pass as amended

Motion Made By Berg Seconded By Warner

Representatives	Yes	No	Representatives	Yes	No
Nicholas	✓		Stefonowicz	✓	
Johnson	✓				
Brusegaard		✓			
Renner Gebert		✓			
Gallert		✓			
Renner		✓			
Brandenburg		✓			
Herbel	✓				
Berg	✓				
Koppang	✓				
Warner	✓				
Froelich	✓				
Schneider	✓				
Mueller	✓				

Total 10 (Yes) 5 (No)

Absent _____

Floor Assignment D. Johnson

If the vote is on an amendment, briefly indicate intent:

REPORT OF STANDING COMMITTEE

HB 1040: Agriculture Committee (Rep. Nicholas, Chairman) recommends **AMENDMENTS AS FOLLOWS** and when so amended, recommends **DO PASS** (10 YEAS, 5 NAYS, 0 ABSENT AND NOT VOTING). HB 1040 was placed on the Sixth order on the calendar.

Page 1, line 1, replace "create and enact a new section to chapter 61-04.1" with "amend and reenact sections 61-04.1-03, 61-04.1-08, 61-04.1-09, 61-04.1-20, 61-04.1-21, 61-04.1-38, and 61-04.1-39"

Page 1, line 2, remove "a statewide" and replace "program" with "operations"

Page 1, line 3, remove "to amend and reenact section 61-04.1-12 of the North Dakota Century Code,"

Page 1, line 4, remove "relating to hail suppression license and permit requirements; to provide an appropriation;"

Page 1, line 5, replace "provide an expiration date" with "repeal section 61-04.1-03.1 of the North Dakota Century Code, relating to the transition from the weather modification board to the atmospheric resource board"

Page 1, line 7, replace "61-04.1-12" with "61-04.1-03"

Page 1, after line 8, replace the remainder of the bill with:

"**61-04.1-03. Definitions.** As used ~~herein~~ in this chapter, unless the context ~~or subject matter~~ otherwise requires:

1. "Board" means the North Dakota atmospheric resource board which, in the exercise of the powers granted ~~herein~~ under this chapter, ~~shall have~~ has all of the powers of an administrative agency as defined in chapter 28-32.

2. "Controller" refers to any licensee duly authorized in this state to engage in weather modification activities.

3. "Geographical region" means a geographical area with a contiguous boundary that may enclose a portion of any county or counties.

4. "Hail suppression" refers to the activation of any process ~~which~~ that will reduce, modify, suppress, eliminate, or soften hail formed in clouds or storms.

~~4.~~ 5. "Increasing precipitation" refers to the activation of any process ~~which~~ that will actually result in greater amounts of moisture reaching the ground in any area from a cloud or cloud system than would have occurred naturally.

~~5.~~ 6. "Initiating precipitation" refers to the process of causing precipitation from clouds ~~that~~ which could not otherwise have occurred naturally or inducing precipitation significantly earlier than would have occurred naturally.

~~6.~~ 7. "Operation" means the performance of any weather modification activity undertaken for the purpose of producing or attempting to produce any form of modifying effect upon the weather within a limited geographical area or within a limited period of time.

~~7.~~ 8. "Research and development" means exploration, field experimentation, and extension of investigative findings and theories of a scientific or technical nature into practical application for experimental and demonstration purposes, including the experimental production of models, devices, equipment, materials, and processes.

~~8.~~ 9. "Weather modification" means and extends to the control, alteration, and amelioration of weather elements including man-caused changes in the natural precipitation process, hail suppression or modification, and alteration of other weather phenomena including clouds, temperature, wind direction, and velocity, and the initiating, increasing, decreasing, and otherwise modifying by artificial methods of precipitation in the form of rain, snow, hail, mist, or fog through cloud seeding, electrification, or by other means to provide immediate practical benefits.

SECTION 2. AMENDMENT. Section 61-04.1-08 of the North Dakota Century Code is amended and reenacted as follows:

61-04.1-08. Powers and duties of board. The board ~~may exercise~~ has the following powers and ~~shall have the following~~ duties:

1. The board shall appoint an executive director to serve at ~~its~~ the board's discretion~~,~~ and to perform ~~such~~ duties ~~as~~ assigned by the board.

2. The board shall authorize the employment of ~~whatever~~ staff ~~it~~ the board deems necessary to carry out the provisions of this chapter. The executive director shall hire the staff, subject to the approval of the board.

3. The board shall adopt rules concerning qualifications, procedures, and conditions for issuance, revocation, suspension, and modification of licenses and permits; standards and instructions governing weather modification operations, including monitoring and evaluation; recordkeeping and reporting, and the board shall establish procedures and forms for ~~such~~ this recordkeeping and reporting. The board may adopt all other rules necessary to the administration of this chapter. The provisions of chapter 28-32 ~~shall~~ apply to this chapter~~,~~ and rules of the board ~~shall~~ must be published in the North Dakota Administrative Code.

4. The board may contract with any person, ~~association, partnership, corporation, or limited liability company, with the federal government, and with any county or groups of counties,~~ as provided in section 61-04.1-20, to carry out weather modification operations and ~~shall~~, in connection with regulated weather modification operations in a county or geographical region, shall carry on monitoring and evaluation activities.

5. The board may order any person who is conducting weather modification operations in violation of this chapter~~,~~ or any rules adopted ~~pursuant~~ to ~~it~~ implement this chapter, to cease and desist from ~~such~~ those operations and the order ~~shall be~~ is enforceable in any court of competent jurisdiction within this state.

6. The board may cooperate and contract with any ~~private~~ person ~~or any local, state, or national commission, organization, or agency~~ engaged in activities similar to the work of the board and may make contracts and agreements to carry out programs consistent with the purpose and intent of this chapter. The board may ~~also, in accordance with law,~~ request and accept any grants of funds or services from any ~~such commission,~~

~~organization,~~ person~~, or agency,~~ and expend ~~such~~ these funds or use ~~such~~ these services to carry out ~~the provisions of~~ this chapter.

7. The board shall monitor the current state of knowledge regarding the magnitude and impacts of possible regional and global climatic changes and shall provide ~~such~~ information to other state agencies that may benefit from ~~such~~ this knowledge.

8. The board shall administer and enforce the provisions of this chapter and do all things reasonably necessary to effectuate the purposes of this chapter.

9. The board may plan and study a hail suppression pilot program that would provide urban and rural hail suppression operations statewide or to any portion of the state.

SECTION 3. AMENDMENT. Section 61-04.1-09 of the North Dakota Century Code is amended and reenacted as follows:

61-04.1-09. Board to establish research and development program - Hail suppression pilot program.

1. The board shall establish a program of weather modification research and development in this state. The board shall supervise and coordinate all research and development activities in the state or research and development activities outside of the state participated in or conducted by any state institution or state or county agency.

2. If the board plans and studies a hail suppression pilot program, the board may conduct a planning phase that includes studying the impact on the environment, providing public education, and formulating an operations plan.

SECTION 4. AMENDMENT. Section 61-04.1-20 of the North Dakota Century Code is amended and reenacted as follows:

61-04.1-20. Board may create operating districts - Representation of noncontracting counties. The board ~~shall have the authority to~~ may place any county ~~contracting~~ or geographical region for which a person contracts with the state for weather modification operations~~,~~ in ~~such an~~ any operational district ~~as~~ the board ~~shall deem~~ determines necessary to best provide ~~such~~ that county or geographical region with the benefits of weather modification. In determining the boundaries of ~~such~~ an operating ~~districts~~ district, the board shall consider the patterns of crops within the state, climatic patterns, and the limitations of aircraft and other technical equipment. The board may assign any county ~~which~~ that has not created a weather modification authority under this chapter to an operating district solely for the purpose of representation on the operations committee of ~~such~~ that district.

SECTION 5. AMENDMENT. Section 61-04.1-21 of the North Dakota Century Code is amended and reenacted as follows:

61-04.1-21. District operations advisory committees created - Duties.

1. There ~~shall~~ must be a district operations advisory committee in each operations district created in accordance with section 61-04.1-20. Each committee ~~shall~~ must be composed of one commissioner of the weather modification authority from each county within ~~such~~ the district, a

representative of each geographical region assigned to the district under section 61-04.1-20, and one member of the board of county commissioners from ~~the~~ each county ~~or counties~~ assigned to the district ~~in accordance with~~ under section 61-04.1-20. Each advisory committee ~~shall~~, upon majority vote, with the concurrence of the board, ~~prescribe~~ shall adopt rules and bylaws necessary to govern ~~its~~ that committee's procedures and meetings. Each committee shall evaluate weather modification operations within ~~its respective~~ that committee's district and make recommendations and proposals to the board concerning ~~such~~ these operations.

2. The weather modification authority of any county authorized to contract for weather modification operations under this chapter ~~and~~ which is not assigned to an operations district~~,~~ shall assume the functions of the district operations committee and ~~shall have and~~ may exercise the powers and duties assigned to the operations committees by this chapter and by the rules of the board.

SECTION 6. AMENDMENT. Section 61-04.1-38 of the North Dakota Century Code is amended and reenacted as follows:

61-04.1-38. Board may receive and expend funds. The board ~~is hereby authorized to~~ may receive and accept in the name of the state any ~~and all~~ funds ~~which may be~~ that are offered or become available from any federal ~~grants~~ grant or ~~appropriations~~ appropriation, private ~~gifts~~ gift, ~~donations~~ donation, or ~~bequests~~ bequest, county funds, or funds from any other source~~,~~ except license and permit fees, and to expend ~~said~~ these funds for the expense of administering this chapter, and, with the exception of county funds, for the encouragement of research and development in weather modification by any private person, the North Dakota state university, the university of North Dakota, or any other appropriate state, county, or public agency in this state ~~either~~ by direct grant, ~~by~~ contract, or ~~by~~ other means.

All federal grants, federal appropriations, private gifts, donations, or bequests, county funds, or funds from any other source~~,~~ except license and permit fees, received by the board ~~shall~~ must be paid over to the state treasurer, who shall credit ~~same~~ this amount to a special fund in the state treasury known as the "~~"~~state weather modification fund~~"~~. All proceeds deposited by the state treasurer in the state weather modification fund are hereby appropriated to the board and ~~shall~~, if expended, must be disbursed by warrant-check prepared by the office of management and budget upon vouchers submitted by the board~~,~~ and ~~shall~~ must be used for the purpose of paying for the expense of administration of this chapter and, with the exception of county funds, for the encouragement of research and development in weather modification by any private person, the North Dakota state university, the university of North Dakota, or any other appropriate state, county, or public agency by direct grant, ~~by~~ contract, or ~~by~~ other means.

SECTION 7. AMENDMENT. Section 61-04.1-39 of the North Dakota Century Code is amended and reenacted as follows:

61-04.1-39. County appropriations - State to provide funds. Any county weather modification authority ~~which has~~ that contracted with the board for weather modification operations under this chapter shall appropriate to the state weather modification fund ~~such~~ the amount ~~as is~~ determined by the board to be necessary to provide ~~such~~ that county with weather modification operations. The board may expend, from the state weather modification fund, ~~such~~ the funds ~~as it~~ the board deems necessary to provide a contracting ~~counties~~ county or geographical region with weather modification operations.

SECTION 8. REPEAL. Section 61-04.1-03.1 of the North Dakota Century Code is repealed."

Renumber accordingly

1999 SENATE AGRICULTURE

HB 1040

1999 SENATE STANDING COMMITTEE MINUTES

BILL/RESOLUTION NO. HB 1040

Senate Agriculture Committee

❑ Conference Committee

Hearing Date 2/25/99

Tape Number		Side A	Side B	Meter #
	1	X		5545-END
	1		X	0-2548
	1		X	4520-END
	2	X		0-1475
2/26	1	X		5600-END
¾	2		X	5775-END
¾	3	X		0-1845
Committee Clerk Signature		Tricia Ferguson		

Minutes:

Senator Wanzek called the meeting order, roll call was taken, all were present.

Senator Wanzek opened the hearing on HB 1040.

Jennifer Clark from the Legislative Council spoke in support of the bill. She went through the bill and explained the changes.

Senator Wanzek: Weather doesn't follow subdivision lines.

Jennifer Clark: I would be speculating if I told you what the reasoning was for geographical region.

Senator Klein: The money is to come from the moneys that are in that particular board.

Jennifer Clark: There is no appropriation clause. If they want to fund it they have the opportunity to go to other entity.

Darin Langerud from NDARB spoke in support of the bill. Testimony enclosed.

Senator Kinnoin: Has there been any headway with Montana as far as being able to fly over their zone?

Darin Langerud: That issue has been with us since 1991.

Senator Klein: What were we doing here with this issue, suppressing hail or creating rain?

Darin Langerud: Both.

Senator Klein: We aren't talking about large amounts of additional rainfall.

Darin Langerud: You're right.

Senator Urlacher: Part of rainfall benefit comes from conversion of hailstone to usable moisture and is that part of that 10%?

Darin Langerud: Yes.

David Sprynczynatyk spoke in support of the bill. Important tool in water management. Proven it does work to suppress hail to enhance rain. Bill will improve how we carry it out.

Senator Klein: With out the money are we accomplishing anything?

Dave Sprynczynatyk: I don't think we are spinning our wheels, we have the opportunity to take the next step.

Senator Urlacher: Since this is scientific is it safe to say it is difficult for people to understand this and don't grab the concept?

Dave Sprynczynatyk: Yes, no doubt it is a science.

Senator Sand: Are there any validity that if we stop hail we will cheat someone out of rain.

Darin Langerud: Study has shown that down wind life is very short.

Senator Urlacher: Are the contracts with foreign countries still being implemented?

Dave Sprynczynatyk: Continue to have contracts overseas.

Mike Dwyer from the NDWMS spoke in support of the bill.

Senator Klein: If we are getting an additional amount of rainfall are other people getting less?

Mike Dwyer: This is an incremental process, by the time it gets that far the process is over and the rainfall is back to the original amount.

Brian Kramer from the Farm Bureau spoke in support of the bill. Just wanted to go on record.

Senator Wanzek closed the hearing on HB 1040.

Discussion was held on the bill.

Senator Sand moved to put a 1 million appropriation back into the bill.

Senator Urlacher seconded.

More discussion was held.

Bill was held for further discussion.

FEBRUARY 26, 1999

Discussion was held.

MARCH 4, 1999

Discussion was held.

Bruce Boe from the Atmospheric Resource Board spoke briefly. Passed out amendments and explained them.

Discussion was held.

Senator Klein made the motion for a Do Pass on the amendments.

Senator Urlacher seconded.

Discussion was held.

Darin Langerud was to the podium for some questions.

Senator Mathern made the motion for a Do Pass as Amended.

Senator Klein seconded.

ROLL CALL: 7 Yes, 0 No

CARRIER: Senator Mathern

Prepared by the Legislative Council staff for
Representative Drovdal
March 4, 1999

PROPOSED AMENDMENTS TO ENGROSSED HOUSE BILL NO. 1040

Page 1, line 15, overstrike "activities" and insert immediately thereafter "operations"

Page 2, after line 19, insert:

"10. "Weather modification authority" means the governing body created by a board of county commissioners under section 61-04.1-22.1, 61-04.1-23, 61-04.1-27, 61-04.1-29, or 61-04.1-31."

Page 3, line 6, overstrike the comma

Page 3, line 8, overstrike "as provided in section 61-04.1-20,"

Page 4, line 30, after "authority" insert ", if a weather modification authority exists,"

Page 4, line 31, replace the underscored comma with an underscored semicolon and after "each" insert "person contracting for a"

Page 5, line 1, replace "under section 61-04.1-20," with an underscored semicolon

Page 5, line 3, remove "under" and overstrike "section 61-04.1-20"

Page 5, line 21, after "funds" insert "and funds from any other person contracting with the board for weather modification operations"

Page 6, line 2, after "funds" insert "or funds from any other person contracting with the board for weather modification operations"

Page 6, line 8, overstrike "**County appropriations**" and insert immediately thereafter "**Payment for weather modification**" and overstrike "county"

Page 6, line 9, after "~~has~~" insert "or person"

Page 6, line 11, remove "that" and overstrike "county" and insert immediately thereafter "that weather modification authority or person"

Page 6, line 13, replace "county" with "weather modification authority or person"

Page 6, line 14, remove "or geographical region"

Renumber accordingly

Date: 3/4
Roll Call Vote #: 1

1999 SENATE STANDING COMMITTEE ROLL CALL VOTES
BILL/RESOLUTION NO. 1040

Senate Agriculture Committee

☐ Subcommittee on _____
or
☐ Conference Committee

Legislative Council Amendment Number 90156.0301

Action Taken Do Pass Amendments

Motion Made By Klein Seconded By Urlacher

Senators	Yes	No	Senators	Yes	No
Senator Wanzek	✓				
Senator Klein	✓				
Senator Sand	✓				
Senator Urlacher	✓				
Senator Kinnoin	✓				
Senator Kroeplin	✓				
Senator Mathern	✓				

Total (Yes) 7 No 0

Absent _____

Floor Assignment _____

If the vote is on an amendment, briefly indicate intent:

Date: 3/4
Roll Call Vote #: 2

1999 SENATE STANDING COMMITTEE ROLL CALL VOTES
BILL/RESOLUTION NO. HB 1040

Senate Agriculture Committee

☐ Subcommittee on _____
or
☐ Conference Committee

Legislative Council Amendment Number _____

Action Taken Do Pass as Amended

Motion Made By Mathern Seconded By Klein

Senators	Yes	No	Senators	Yes	No
Senator Wanzek	✓				
Senator Klein	✓				
Senator Sand	✓				
Senator Urlacher	✓				
Senator Kinnoin	✓				
Senator Kroeplin	✓				
Senator Mathern	✓				

Total (Yes) 7 No 0

Absent _____

Floor Assignment Senator Mathern

If the vote is on an amendment, briefly indicate intent:

REPORT OF STANDING COMMITTEE

HB 1040, as engrossed: Agriculture Committee (Sen. Wanzek, Chairman) recommends **AMENDMENTS AS FOLLOWS** and when so amended, recommends **DO PASS** (7 YEAS, 0 NAYS, 0 ABSENT AND NOT VOTING). Engrossed HB 1040 was placed on the Sixth order on the calendar.

Page 1, line 15, overstrike "activities" and insert immediately thereafter "operations"

Page 2, after line 19, insert:

"10. "Weather modification authority" means the governing body created by a board of county commissioners under section 61-04.1-22.1, 61-04.1-23, 61-04.1-27, 61-04.1-29, or 61-04.1-31."

Page 3, line 6, overstrike the comma

Page 3, line 8, overstrike "as provided in section 61-04.1-20,"

Page 4, line 30, after "authority" insert ", if a weather modification authority exists,"

Page 4, line 31, replace the underscored comma with an underscored semicolon and after "each" insert "person contracting for a"

Page 5, line 1, replace "under section 61-04.1-20," with an underscored semicolon

Page 5, line 3, remove "under" and overstrike "section 61-04.1-20"

Page 5, line 21, after "funds" insert "and funds from any other person contracting with the board for weather modification operations"

Page 6, line 2, after "funds" insert "or funds from any other person contracting with the board for weather modification operations"

Page 6, line 8, overstrike "**County appropriations**" and insert immediately thereafter "**Payment for weather modification**" and overstrike "county"

Page 6, line 9, after "~~has~~" insert "or person"

Page 6, line 11, remove "that" and overstrike "county" and insert immediately thereafter "that weather modification authority or person"

Page 6, line 13, replace "county" with "weather modification authority or person"

Page 6, line 14, remove "or geographical region"

Renumber accordingly

1999 HOUSE AGRICULTURE

HB 1040

CONFERENCE COMMITTEE

1999 HOUSE STANDING COMMITTEE MINUTES

BILL/RESOLUTION NO. HB 1040

House Agriculture Committee

☒ Conference Committee

Hearing Date 3-30-99

Tape Number	Side A	Side B	Meter #
One HB 1040	x		0.0 to 16.0
Committee Clerk Signature			

Minutes:

Conference committee on HB 1040 Chm Rep D Johnson, Rep Mueller, Rep Renner, Sen Wanzek, Sen Urlacher, Sen D Mathern, Chm Johnson called the committee to order.

Clerk took the roll and all were present.

Summary of bill.. Relates to statewide hail suppression pilot program by the Atmospheric Resource Board.

Chm Rep Johnson: HB 1040 deals with weather modification bill that was passed early on in the House and passed over to the Senate. Understand the Senate has amended the bill further.

Sen Wanzek: I should of made the Senators aware of the new amendment requested by some people. I really have no vested interest in this amendment but when these people called I said we would have to have conference committee to address the matter. They had called me after we had

passed the bill out of the Senate. I asked the Legislative Council if the Counties didn't have this authority as the bill is written to do what they are asking to be able to do. Their answer was no. Jennifer Clark said we would have to have the amendment in order to do what they want to do. The western portion is basically grazing land and does not benefit that much from the Weather Modification program. They feel the benefits are minimal to them. As a consequence they wished to opt out of the program and not be taxed for its implementation.

The eastern part of the county has more farming and feel they would have more benefits from the Weather Modification program.

Sen Urlacher: Slope county was one of the first counties to ask for Weather Mod and feels the eastern ½ has benefited tremendously from the program. Before the program Hail Ins premiums were 20% or higher and some companies wouldn't even write hail insurance in that county now with the program premiums have dropped to 14% to 15%.

Sen Mathern: As the bill was written I it thought would take care of this. When they put geographical region in the wording of the bill I thought this would do that. Now we take that out and do something else will that do what we want accomplished.

Sen Wanzek: Jennifer Clark said an individual portion of the county could not participate without the entire county going with it.

Rep Muller: Taxation area is referred to in the amendment whereas it is not in the original bill.

Sen Wanzek: Original bill said you had to tax all the county or none.

Chm Johnson: Where do you draw the lines? Township lines or what.

Sen Urlacher: Should be able to define the area by township lines.

Rep Mueller: Should be able to draw the lines according to sub-division (township).

It's going to hard to define the actual area covered for taxation purposes because you aren't going to have hail or rainfall on one side of a line and not the other. I guess this would give that county the chance to sit down and talk that over. If we adopt this amendment we will be laying a lot back on those folks but at least they'll have the opportunity to do that.

Sen Wanzek: The language says the weather modification authority may certify annually to the board of County Commissioners a tax for weather modification fund of not to exceed seven mills upon taxable valuation of the property in the county designated to receive weather modifications services.

Sen Wanzek moves that the House accede to the Senate amendments and that we further amend HB 1040 with amendments proposed by Sen Wanzek. Second by Rep Mueller.

Vote total YES 6 NO 0 ABSENT 0 Motion prevailed.

Sen Wanzek then moved to approve the amendments to HB 1040 of Mar 15, 1999. 90156.0303

Second by Rep Renner

Vote Total YES 6 NO 0 ABSENT O Motion prevailed

Carrier Rep D. Johnson

VR
3/30/99

90156.0303
Title.0500

Prepared by the Legislative Council staff for
Senator Wanzek
March 15, 1999

CONFERENCE COMM. AMENDMENTS TO ENGROSSED HOUSE BILL NO. 1040 AGR 3-30-99

That the House accede to the Senate amendments as printed on page 789 of the House Journal and pages 642 and 643 of the Senate Journal and that Engrossed House Bill No. 1040 be further amended as follows:

Page 1, line 2, after the second comma insert "61-04.1-26,"

CONFERENCE COMMITTEE AMENDMENTS TO ENGROSSED HOUSE BILL NO.1040 AGR 3-30-99

Page 5, after line 13, insert:

"**SECTION 6. AMENDMENT.** Section 61-04.1-26 of the North Dakota Century Code is amended and reenacted as follows:

61-04.1-26. Tax may be certified by weather modification authority. The weather modification authority may certify annually to the board of county commissioners a tax of not to exceed seven mills upon the taxable valuation of the property in the county for a "weather modification" fund. If weather modification services are not provided to the entire county, the weather modification authority may certify annually to the board of county commissioners a tax for a weather modification fund of not to exceed seven mills upon the taxable valuation of the property in the county designated to receive weather modification services. The tax shall be levied by the board of county commissioners and may be levied in excess of the mill levy limit fixed by law for taxes for general county purposes. The weather modification fund shall be used only for weather modification activities in conjunction with the state of North Dakota. The tax certified by the weather modification authority is limited to the period of existence of the weather modification authority as provided for in this chapter."

Renumber accordingly

REPORT OF CONFERENCE COMMITTEE
(ACCEDE/RECEDE) - 420

07398

(Bill Number) HB 1040 (, as (re)engrossed):

Your Conference Committee

For the Senate:			For the House:		
Sen Wanzek	yes	yes	Rep D. Johnson	yes	yes
Sen Urlacher	yes	yes	Rep Renner	yes	yes
Sen D. Mathern	yes	yes	Rep Mueller	yes	yes

☒ recommends that the (SENATE/HOUSE) (ACCEDE to) (RECEDE from)
~~723/724~~ 725/726 S724/H726 S723/H725
the (Senate/House) amendments on (SJ/HJ) page(s) _____ - _____

☐ and place _____ on the Seventh order.
727

☒ , adopt (further) amendments as follows, and place

_____ on the Seventh order:

☐ having been unable to agree, recommends that the committee be discharged and a new committee be appointed. 690/515

((Re)Engrossed) _____ was placed on the Seventh order of business on the calendar.

DATE: 3 / 30 / 99

CARRIER: _____

LC NO. _____ . _____ of amendment

LC NO. _____ . _____ of engrossment

Emergency clause added or deleted _____

Statement of purpose of amendment _____

(1) LC (2) LC (3) DESK (4) COMM.

REPORT OF CONFERENCE COMMITTEE

HB 1040, as engrossed: Your conference committee (Sens. Wanzek, Urlacher, D. Mathern and Reps. D. Johnson, Renner, Mueller) recommends that the **HOUSE ACCEDE** to the Senate amendments on HJ page 789 and place HB 1040 on the Seventh order.

That the House accede to the Senate amendments as printed on page 789 of the House Journal and pages 642 and 643 of the Senate Journal and that Engrossed House Bill No. 1040 be further amended as follows:

Page 1, line 2, after the second comma insert "61-04.1-26,"

Page 5, after line 13, insert:

"**SECTION 6. AMENDMENT.** Section 61-04.1-26 of the North Dakota Century Code is amended and reenacted as follows:

61-04.1-26. Tax may be certified by weather modification authority. The weather modification authority may certify annually to the board of county commissioners a tax of not to exceed seven mills upon the taxable valuation of the property in the county for a "weather modification" fund. If weather modification services are not provided to the entire county, the weather modification authority may certify annually to the board of county commissioners a tax for a weather modification fund of not to exceed seven mills upon the taxable valuation of the property in the county designated to receive weather modification services. The tax shall be levied by the board of county commissioners and may be levied in excess of the mill levy limit fixed by law for taxes for general county purposes. The weather modification fund shall be used only for weather modification activities in conjunction with the state of North Dakota. The tax certified by the weather modification authority is limited to the period of existence of the weather modification authority as provided for in this chapter."

Renumber accordingly

Engrossed HB 1040 was placed on the Seventh order of business on the calendar.

1999 TESTIMONY

HB 1040

HB-1040
House Agriculture Committee
Bruce A. Boe, Director, Atmospheric Resource Board
January 21, 1999

Good morning, Mr. Chairman, and members of the committee. For the record, I am Bruce Boe, the Director of the Atmospheric Resource Board. House Bill 1040 would establish a program for hail damage mitigation statewide, at a cost in the next biennium of $3.1 million dollars. My testimony this morning will provide some background, before Darin Langerud, the Board's Chief Meteorologist, presents the project scope, organization, and costs. I will also summarize the most recent economic evaluation of the program, completed just last month. The Atmospheric Resource Board has reviewed this legislation, and supports it.

In North America, hail suppression technology is presently being applied in North Dakota, Kansas, Oklahoma, and Alberta, Canada. While the American programs are all driven primarily by agriculture (crop-hail reduction) interests, the Canadian program is driven and funded by property and casualty insurance interests. Evaluations based upon crop-hail insurance data indicate significant reductions in damage; 45% in North Dakota[1], and 27% in Kansas[2]. The Oklahoma and Alberta operations are too new to be evaluated in a meaningful way.

Hail suppression works by accelerating ice-phase precipitation processes, resulting in faster development of rain, and conversion of a greater percentage of the cloud liquid water to smaller particles, which melt into rain as they fall through the warm subcloud air on the way to the ground. Incremental increases in storm-total rainfall on the order of 15% have been observed as a result of these efforts[3]. I here note that operations do not eliminate hail, nor do they create large amounts of additional rainfall. However, the reduction in crop-hail damage is significant, and given that North Dakota climatologically speaking is (usually) semi-arid, the incremental rainfall received is also beneficial.

To determine the magnitude of these impacts, researchers at NDSU recently examined production, prices, and acreage statistics for the 1988-1997 period, and calculated the economic value of hail suppression operations for North Dakota on a county-by-county basis[4]. This study considered only wheat, barley, oats, sunflowers, corn (grain), flax, soybeans, and dry edible beans. Copies of the study have been provided to committee members and are available to others upon request.

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[1]*Journal of Applied Meteorology*, May, 1997, American Meteorological Society, Boston.

[2]Kansas Water Office, 1995, Topeka, Kansas.

[3]H. Johnson, *An Evaluation of the North Dakota Cloud Modification Project*, 1985.

[4]R.S. Sell and R.L. Leistritz, *Economic Impact of Reducing Hail and Enhancing Rainfall in North Dakota*, 1998.

This recent study projects annual statewide direct benefits of $87 million, and an increased business volume of $267 million, which would generate $5.1 million per year additional revenue to the state general fund. The effects of increased wheat production on wheat prices are also considered. Even though forage crops, high-value crops such as sugar beets and potatoes, and potential reductions in property-hail damage were not included, the state revenue projections are about double the cost of the proposed statewide project. This information is summarized in the fiscal note attached to the bill.

In the context of the present hail suppression project, operations are conducted around the clock, seven days each week, as weather conditions dictate and safety allows. Provisions are built into the decision-making criteria which provide for the immediate cessation of seeding when prudence dictates. If a choice must be made between treating a storm or keeping aircraft on the ground because of unsafe flight conditions, the latter course is always pursued. Tornadic storms are never seeded, even though they are often hailers. The results reported have been achieved in spite of these necessary precautions. Similar safeguards would be implemented in the proposed statewide project. In addition, significant effort will be made to ensure local involvement in the day-to-day decision making. Darin will provide more on these program aspects when he presents estimated costs.

From the mid-1980s through 1997, the Atmospheric Resource Board engaged in cooperative research with the National Oceanic and Atmospheric Administration (NOAA). The research examined basic cloud processes which produce rain and hail, and how those processes might and might not be successfully modified. Much was learned about cloud processes, cloud seeding, and precipitation development. During this period, well over 100 formal publications and technical papers were produced. In short, we know a great deal about when and how cloud modification can be successful, though we continually strive to learn more. If you have questions about how precipitation develops or when and how seeding works, please ask. Time constraints today preclude my describing these processes in the detail they deserve.

With the Chair's approval, I'll now turn the podium over to the Atmospheric Resource Board's Chief Meteorologist, Mr. Darin Langerud.

TESTIMONY

Prepared by Representative David Drovdal

Wednesday, January 13, 1999

Chairman Nicholas and Members of the Agriculture Committee. For the record, my name is Representative David Drovdal and I serve District 39 which includes Slope, Billings, Bowman, Golden Valley counties, and most of McKenzie County.

The draft bill before you expands the current hail suppression program from the current 5 counties to a state-wide system. It came from the interim Insurance and Health Care Committee after many pages of testimony on the cost and effect of a program. The testimony came from insurance companies, NDSU studies, the state Atmospheric Resource Board, counties that currently have hail suppression, the Albert Hail suppression organization, and interested individuals. We had received testimony based on the existing programs in and out of North Dakota. These testimonies told us that we could expect to see hail losses reduced by 45% across the state, providing a direct benefit. The direct impact of hail reduction was $34 million and the direct impact of rainfall enhancement was $52 million state-wide, which resulted in a total direct impact of nearly $87 million annually. This direct impact results in an increase in total business activity of $267 million on an average of $14.52 per planted acre. Additional potential benefits would be reduction in loss of property damage for those not having insurance. Remember that our information was based on data only from those who had insurance. Rainfall would be expected to increase on the order of 7 to 15% and, according to NDSU estimates, the direct economic benefit from that would be $177.6 million in a state-wide program. That translates into added business volume of $676.5 million. The information showed an increase of nearly 6% in targeted areas and that would translate to $16 million per year, just for wheat. The Committee heard testimony from hail suppression programs outside the state. It was interesting to note that these programs were patterned after our own programs.

It was also reported that hail losses since 1990 have drastically increased with many insurance companies looking at increased deductibles, increasing rates or, in at least one case, stopping the writing of policies in parts of North Dakota (Kent Olson testimony on 7/25/97). NoDak Mutual provided us with a comparison that crop hail losses outside the targeted area are $77/100 and within the five-county

target area, they reported a $44/100 loss (3/5/98). Remember that the target area consisted of five counties that originally had the highest hail loss in the state. These results came from studies that, in some cases, have been ongoing for decades. When polled, 70% of the people in the targeted area felt that hail suppression works.

The cost of a state-wide hail suppression operation would be $3.2 million annually. The revenue that would be projected by additional sales tax and income tax should more than cover the cost of the project. Therefore, I would request that the appropriation come from the general fund rather than new taxes. The revenue has been projected at $5.1 million annually.

As we watch with dismay the plight of our farm economy, this is but an investment in our farmers. Hail suppression has a track record of success; it does return dollars into the economy. We have sufficient data to verify that. It also helps the property owners. Some say we should not mess with mother nature, then those same people go out and plant treated seed using fertilizer and pesticides to control weeds and insects. Again, Committee, I thank you for your time and ask for your favorable recommendation.

Respectfully submitted by:

Representative David Drovdal

Testimony, HB 1040
Darin Langerud, Chief Meteorologist, Atmospheric Resource Board
House Agriculture Committee
January 21, 1999

Mr. Chairman and members of the committee, my name is Darin Langerud, Chief Meteorologist of the Atmospheric Resource Board. Today I will present to you the planning process through which an operations plan will be formulated, and a preliminary model plan for the design and implementation of a statewide hail suppression program. I ask that you please bear in mind that this is a preliminary design subject to change by recommendations of the Hypothesis Assessment and Safety Committees, and that budgeted figures are estimates only.

House Bill 1040 calls for the Board to implement a statewide hail suppression pilot program that provides urban and rural hail suppression services. Year one of this process would include a study of the environmental impact of the project, provide public education, and convene Hypothesis Assessment and Safety Committees of national experts in cloud seeding operations to best formulate an operations plan. Year two calls for statewide implementation of a hail suppression program.

The first item of business in the planning phase would be bringing in qualified people to assist in doing the work. The Board currently has a full-time staff of three and would need to add personnel to assist in the huge workload increase that a statewide program would generate. Six additional FTE's would be required to provide specific functions ranging from clerical and administrative support, meteorological and operational support and training, and public education. Temporary staff would be required to perform the operational duties in the field phase of the program. Meteorologists would be hired by the Board to staff the radars, while the successful aircraft contractor(s) would supply the pilots-in-command. The Board would also hire intern meteorologists and intern pilots through our existing cooperative agreement with the University of North Dakota's Center for Aerospace Sciences. These interns have and would continue to provide a pool of experienced and trained people to work in lead positions in subsequent years.

The planning phase also includes a provision for an environmental impact study to address any concerns of that nature. An EIS is also a prerequisite to acquiring a permit from the State of Montana to obtain a seeding buffer zone used to affect storms entering North Dakota's western counties as they cross our border.

Hypothesis Assessment and Safety Committees consisting of national experts in the field would be convened to address the design, safeguards, and implementation of a statewide program. These committees would consider the latest technology of seeding agents and methods and operational application techniques and design. The safe and prudent application of these methods would also be considered in an operational and situational context. The current North Dakota Cloud Modification Project (NDCMP) Operations Manual and NDCMP Radar Manual would likely be the foundation from which the statewide operations plan would be

modeled. In addition to the design and implementation of the program, the operations plan would also include a process in which local delegates are designated and provided an opportunity for stating any local concerns toward the proposed plan, and just as importantly, provided a voice during the operations phase of the program. The Board's Administrative Rules and Regulations also contain provisions for the handling of unforseen concerns.

Next I would like to present a preliminary model plan for a statewide program. Again, this is only preliminary and would likely contain changes in structure and cost as it develops through the planning phase. North Dakota's current program serves six western counties and is conducted with two radars and nine aircraft. This design applies one seeding aircraft for every 1,262 square miles. A program with the same design statewide would require 56 aircraft, financially and logistically unfeasible. Economy of scale is an important advantage in the context of a statewide program. With daily weather forecasts, aircraft can be repositioned to areas where weather is more likely to occur, bolstering the infrastructure in that area. This would provide maximum benefit of each seeding aircraft on the program, while holding down costs. The ideal number of aircraft for a statewide project is difficult to determine. Too few and the efficacy of the program suffers, too many and the financial cost becomes unrealistic.

The initial statewide program proposed to the interim Insurance and Health Care Committee included twenty-four aircraft and a cost estimate of approximately $3.25 million. That proposal called for a three year implementation plan by phasing in the operations program over a two year period with a cost estimate of $5.4 million over the three year period. The committee asked that proposals for three different target areas, west, west and central, and statewide be developed and that costs be scaled back where possible. The result is the $3.1 million bill before you. That program has been slightly redesigned to address some logistical problems and updated to reflect the most current cost estimates. The program calls for four radars and twenty aircraft at a cost of $2.9 million for the operational year and $3.35 million for the biennium. It is staff's opinion that twenty aircraft statewide may be shy of the optimal design, but that question would be addressed in the planning phase. It is also staff's opinion that phasing in the field operations over a two year period would be the better route as going statewide in the first year of field operations would be extremely difficult. Going that route, biennial cost estimates would be near $2.3 million for the first biennium and approximately $6.1 million the next, still far below the $10.2 million estimate of increased general fund biennial revenue in the Sell and Leistritz report.

In closing, I would say that though this bill did not originate with agriculture in mind, it is probably most at home here. I have no doubt that hail suppression on the order of 45% statewide would be advantageous to property owners and insurance companies, as well as farmers. The problem in quantifying its efficacy on property is one of insufficient and convoluted data, something that House Bill 1313 would correct. But this program was born in agriculture in southwestern North Dakota in the 1950's and its evaluations, of which all are positive, have an agricultural flavor. With all of the uncertainty that faces the family farmer, this program, on its merits, could have a significant impact to their bottom line and North Dakota's agricultural economy in general.

Preliminary Statewide Operations Model

- ❑ Four target districts split along county boundaries and shaded in color.
- ❑ Four radars, one in each district, in Stanley, Dickinson, Devils Lake, and Jamestown, with the maximum radar coverage indicated for each by the corresponding circle.
- ❑ Twenty aircraft, sixteen cloud-base, and four cloud-top, with four and one respectively in each district.
- ❑ Field operations would run from May 15 through September 15.

Statewide Hail Suppression Operations Hybrid Plan
Four districts, four radars, 20 aircraft.

Year One Costs

Operational and Environmental Scoping

		Total
Environmental Impact Study		$150,000
Hypothesis Assesment Comm.		$15,000
Safeguards Comm.		$15,000
	Total	$180,000

Staffing	Number	Salary/Mo.	Bene./Mo.	Tot./Mo.	Total
Env. Scientist II	2	$2,711	$759	$3,470	$83,280
Admin. Asst. I	2	$1,891	$530	$2,421	$58,104
Pub. Info. Spec. II	1	$2,475	$693	$3,168	$38,016
Admin. Sec. II	1	$1,532	$429	$1,961	$23,532
				Total	$202,932

Misc./Pub. Info.

		Total
Research Fees		$25,000
Contract Fees		$25,000
Travel		$10,000
Media Fees		$1,500
Supplies/Postage		$1,500
Printing Fees		$2,500
	Total	$65,500

Total Year 1 estimate:	$448,432

Year Two Costs

Statewide Field Operations Cost Estimates

Aircraft	Mobilization	Lease	# A/C	$/ Flt. Hr.	# Flt. Hrs.	Total Cost
Cloud Base	$2,163	$39,827	16	$84	3,200	$940,640
Cloud Top	$7,519	$92,013	4	$309	1000	$707,128

Aircraft Cost Phase II	$1,647,768

Radar Systems	#Systems	Ops. Cost	Tech. Supp.	Install.	TITAN	Total Cost
Contractor Radars	3	$115,332	$38,070	$6,600	N/A	$160,002
ARB Radars	1	$10,000	$12,800	N/A	$7,500	$30,300

Radar Cost Year 2	$190,302

Seeding Chemicals	Units	Price/Unit	Total Cost
Dry Chemicals	1900	$90.00	$171,000
Ejectable Flares	8000	$22.50	$180,000
Burn In Place Flares	2800	$35.00	$98,000
Dry Ice	100000	$0.46	$46,000

Seeding Chemicals Cost Year 2	$495,000

Miscellaneous

Contract fees, I.T. Hard/Soft, Grnd Schl, Travel/Delivery/Freight, Comm. fees, Chem storage, weather data, Newspaper fees/Pub info, Supplies	$105,000

Misc. Cost Year 2	$105,000

Staff (Bis)			Sal./Mo.	Bene./Mo.	Tot./Mo.	Total
Six FTE's			$13,607	$3,811	$17,418	$209,020
Field Staff	#	# of Months				
Field Met's.	9	4.25	$2,500	$300	$2,800	$107,100
Intern Met's.	5	4	$1,500	$180	$1,680	$33,600
Intern Co-Pilots	28	116 Days	$35 per Day	N/A	N/A	$113,680

Staff Cost Year 2	$463,400

Total Cost Year 2	$2,901,470

Total Estimated Cost Years 1 and 2:	**$3,349,902**

Projected costs years 3 through 6:
(3% increases across the board)

Year 3	Year 4	Year 5	Year 6
$2,988,514	$3,078,169	$3,170,515	$3,265,630

Five year field operations total cost:	$15,404,298	5 Year Avg:	$3,080,860
Five year total cost per acre:	$0.34	5 Year Avg:	$0.068

Statewide Hail Suppression Operations Plan (Phase-In)
Two districts, two radars, 13 aircraft.

Year One Costs

Operational and Environmental Scoping		Total
Environmental Impact Study		$150,000
Hypothesis Assesment Comm.		$15,000
Safeguards Comm.		$15,000
	Total	$180,000

Staffing	Number	Salary/Mo.	Bene./Mo.	Tot./Mo.	Total
Env. Scientist II	2	$2,711	$759	$3,470	$83,280
Admin. Asst. I	1	$1,891	$530	$2,421	$29,052
Pub. Info. Spec. II	1	$2,475	$693	$3,168	$38,016
Admin. Sec. II	1	$1,532	$429	$1,961	$23,532
				Total	$173,880

Misc./Pub. Info.		Total
Research Fees		$25,000
Contract Fees		$25,000
Travel		$10,000
Media Fees		$1,500
Supplies/Postage		$1,500
Printing Fees		$2,500
	Total	$65,500

Total Year 1 estimate:	$419,380

Year Two Costs

Western ND Field Operations Cost Estimates

Aircraft	Mobilization	Lease	# A/C	$/ Flt. Hr.	# Flt. Hrs.	Total Cost
Cloud Base	$2,163	$39,827	10	$84	1,800	$571,100
Cloud Top	$7,519	$92,013	3	$309	600	$483,996

Aircraft Cost Year 2	$1,055,096

Radar Systems	#Systems	Ops./Parts	Tech. Supp.	Install.	TITAN	Total Cost
Contractor Radars	1	$38,444	$12,690	$2,200	N/A	$53,334
ARB Radars	1	$10,000	$12,800	N/A	$7,500	$30,300

Radar Cost Year 2	$83,634

Seeding Chemicals	Units	Price/Unit	Total Cost
Dry Chem.	1070	$90.00	$96,300
Ej. Flares	5000	$22.50	$112,500
B-I-P Flares	1750	$35.00	$61,250
Dry Ice	75000	$0.46	$34,500

Seeding Chemicals Cost Year 2	$304,550

Miscellaneous

Contract fees, I.T. Hard/Soft, Grnd Schl, Travel/Delivery/Freight, Comm. fees, Chem storage, weather data, Newspaper fees/Pub info, Supplies	$87,500

Misc. Cost Year 2	$87,500

Staff (Bis)			Sal./Mo.	Bene./Mo.	Tot./Mo.	Total
Five FTE's			$11,660	$2,483	$14,143	$169,715
Field Staff	#	# of Months				
Field Met's.	5	4.25	$2,500	$300	$2,800	$59,500
Intern Met's.	3	4	$1,500	$180	$1,680	$20,160
Intern Co-Pilots	19	116 Days	$35 per Day	N/A	N/A	$77,140

Staff Cost Year 2	$326,515

Total Cost Year 2	$1,857,295

Total Estimated Cost Years 1 and 2:	**$2,276,675**

Statewide expansion in Year 3

Projected costs years 3 through 6:
(3% increases across the board)

Year 3	Year 4	Year 5	Year 6
$2,988,514	$3,078,169	$3,170,515	$3,265,630

Five year field operations total cost:	$14,360,123	5 Year Avg:	$2,872,025
Five year total cost per acre:	$0.32	5 Year Avg:	$0.063

HB-1040
Testimony
Wayne Mrnak, Bowman

Mr. Chairman and committee members, for the record, my name is Wayne Mrnak; I ranch in Bowman County.

Hail suppression operations have been conducted in my area for a long time, and from my perspective, have done a lot of good. We have less hail than we used to, and a little more rain.

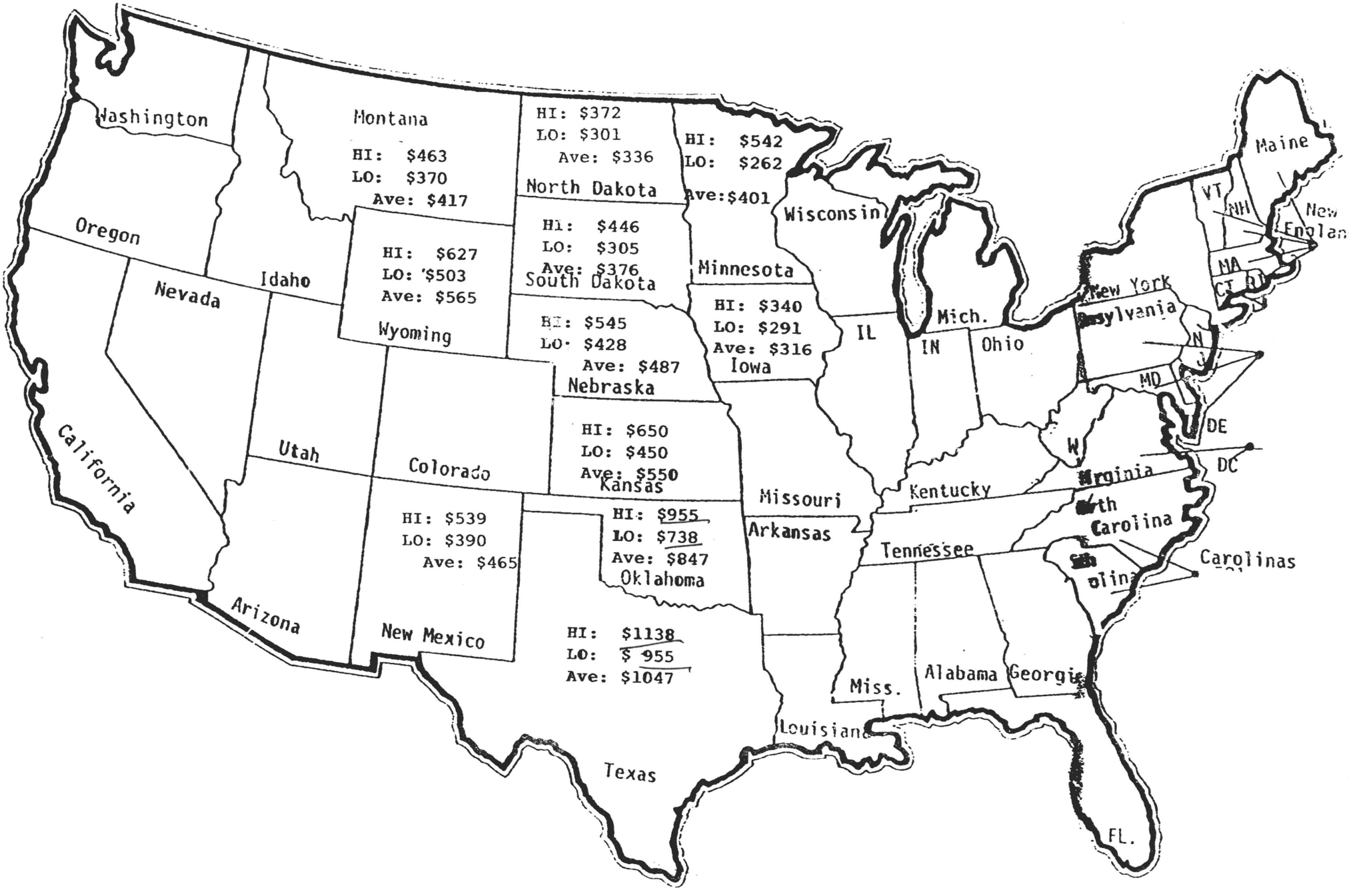
House Bill 1040 is the result of an interim study by the Insurance and Health Care Committee. I agree with that committee, I think it is a good idea, too. I know the price tag is big, but from my own experience, I'm sure the program will pay back way more than it costs.

I encourage the committee to examine the facts carefully, and to be far-sighted enough to realize that the program will more than pay for itself.

Anything that can be done to help rural North Dakota right now is a good idea.

Thank you.

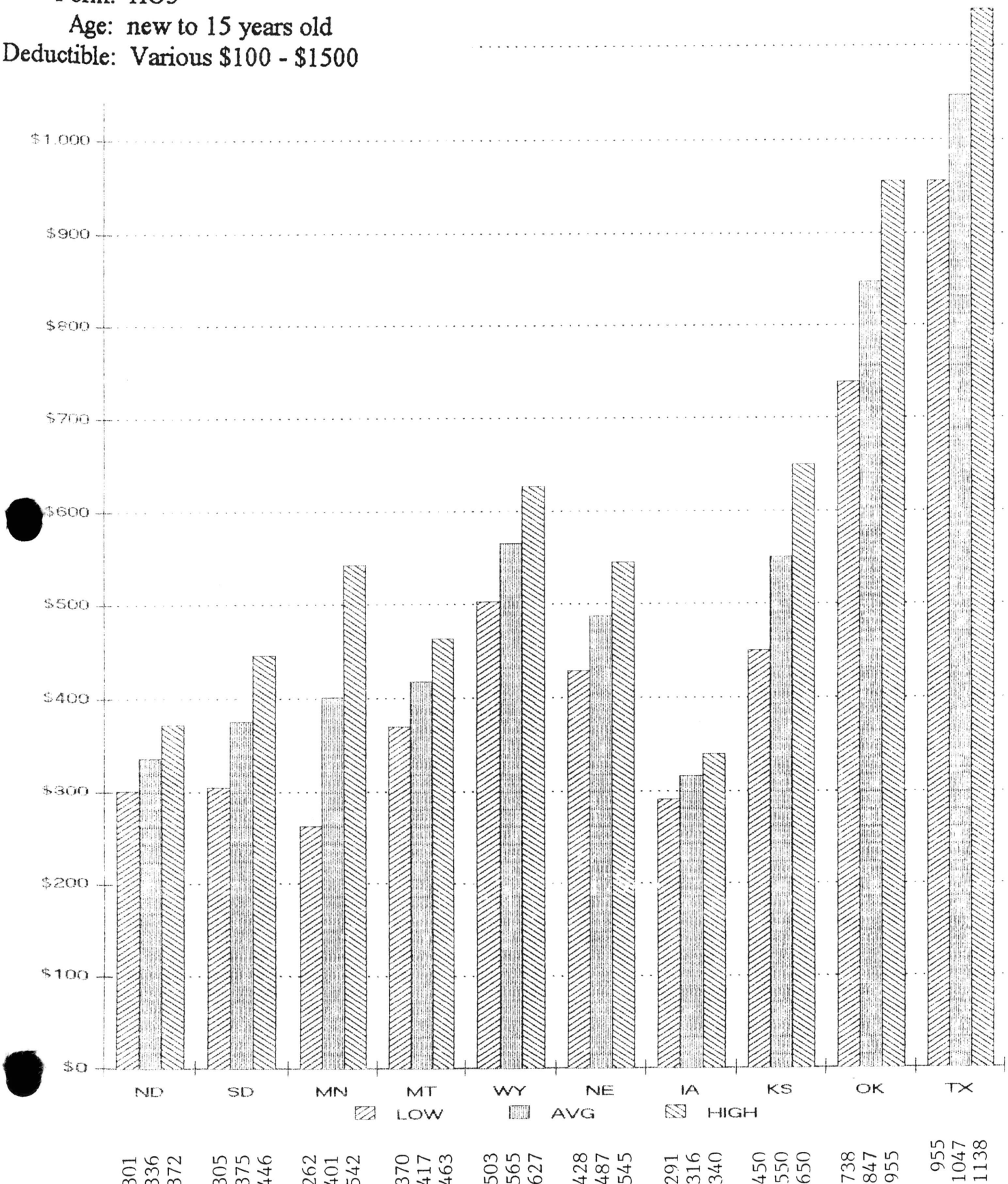
Illustration of Participation



HOMEOWNERS PREMIUM COMPARISON

MIDWEST STATES

[redacted]mount: $100,000 dwelling
Form: HO3
Age: new to 15 years old
Deductible: Various $100 - $1500



HOMEOWNERS PREMIUM SURVEY (10-15-97)

City/States Surveyed:		General Underwriting
North Dakota:	Bismarck Fargo Dickinson	GRC on Dwlg/Roof/Conts $100-$250 Deduct $500 some Cos on Roofs/W&H ACV credits or ACV only 15 Yrs
South Dakota:	Pierre Rapid City Clear Lake	GRC on Dwlg/Roof/Contents $250-$500 Deduct all perils No "special underwriting"
Minnesota:	Fergus Falls Finlayson White Bear Lake	GRC on Roof/ Dwlg/ Contents $250 Deduct all perils No "special underwriting"
Montana:	Great Falls Billings Havre	GRC on Dwlg/Roof/Contents $500-$1000 Mandatory Deduct on roof. Varies with wood roof and W&Hail only deducts
Nebraska:	Pierce Wayne	GRC on on roofs 10 yrs & LESS ACV on over 10 Yrs $250 Ded all perils
Kansas:	McPherson Fredonia Louisberg	GRC on Dwlg/Roof/Contents $500 all perils w/ 1% W&Hail May NOT write wood roofs or only ACV if written
Oklahoma:	Enid Oklahoma City	GRC on Dwlg & Conts. ACV on roofs over 10 Yrs old $250 D. Premium Surcharge on Wood Roofs Premium Surcharge for R/C
Texas:	Houston Spring Austin	GRC on Dwlg/Conts. ROOF either. $250 Ded w/1% W/H/H up to 5% No roofs over 15 Yrs old Over 15 yrs ACV only
Wyoming:	Cheyenne Jackson Sundance	GRC on Dwlg/Roof/Contents $250 Ded Surchage on wood roof Cheyenne area rates double Surcharged if 2 or more losses in 3 years & Coverage reduced to Basic HO

Key: GRC = Guranteed Replacement Cost
ACV = Actual Cash Value (RC less Depreciation)
W/H/H = Wind, Hail. Hurricane

NORTH DAKOTA
Atmospheric Resource Board
A DIVISION OF THE NORTH DAKOTA STATE WATER COMMISSION
900 EAST BOULEVARD • BISMARCK, NORTH DAKOTA 58505-0850 • (701) 328-2788 • FAX (701) 328-4749 • TDD (701) 328-2750

MEMORANDUM

DATE: 18 JANUARY 1999

TO: HOUSE AGRICULTURE COMMITTEE

FROM: BRUCE BOE, DIRECTOR

RE: ECONOMICS OF HAIL SUPPRESSION AND INCREASED RAINFALL

Dear Committee Members:

The enclosed report is provided for your information relative to House Bill 1040, which would establish a statewide hail suppression pilot project, presently scheduled for hearing on Thursday, January 21.

This just-completed evaluation was performed by Randall Sell and Larry Leistritz of the Agricultural Economics Department at NDSU. An executive summary is provided just inside the cover.

This report does not consider benefits to any crops other than the eight specifically mentioned, nor benefits realized by any reduced damage to property. Yet, projected revenues to the general fund significantly exceed the program cost.

If you have questions, please ask when HB-1040 is heard.

enc: economic evaluation

NORTH DAKOTA
Atmospheric Resource Board
A DIVISION OF THE NORTH DAKOTA STATE WATER COMMISSION
900 EAST BOULEVARD • BISMARCK, NORTH DAKOTA 58505-0850 • (701) 328-2788 • FAX (701) 328-4749 • TDD (701) 328-2750

MEMORANDUM

DATE: 24 FEBRUARY 1999

TO: SENATE AGRICULTURE COMMITTEE

FROM: DARIN LANGERUD, CHIEF METEOROLOGIST

RE: ECONOMICS OF HAIL SUPPRESSION AND INCREASED RAINFALL

Dear Committee Members:

The enclosed report is provided for your information relative to House Bill 1040, which as amended would clarify some of the language in chapter 61-04 of the North Dakota Century Code and allow the Atmospheric Resource Board to study a statewide hail suppression program. The hearing on HB 1040 is presently scheduled for hearing on Thursday, February 25.

This just-completed evaluation was performed by Randall Sell and Larry Leistritz of the Agricultural Economics Department at NDSU. An executive summary is provided just inside the cover.

This report does not consider benefits to any crops other than the eight specifically mentioned, nor benefits realized by any reduced damage to property. Yet, projected revenues to the general fund significantly exceed the program cost.

I will briefly discuss the report in my testimony. If you have questions, please ask when HB-1040 is heard.

enc: economic evaluation

HB 1040
Senate Agriculture Committee
Darin W. Langerud, Chief Meteorologist, Atmospheric Resource Board
February 25, 1999

Good morning, Mr. Chairman and members of the committee. For the record, I am Darin Langerud, chief meteorologist of the Atmospheric Resource Board. House Bill 1040 has undergone major changes since it was first introduced by Legislative Council in the House. It was a product of an interim study by the Insurance and Health Care Committee to look at the feasibility and desirability of implementing a statewide hail suppression program for urban and rural areas. The interim committee passed the bill with a six year statewide pilot program consisting of one year of planning and five subsequent years of operations. HB 1040 sought to set forth the first two years of that process with a total price tag of $3.1 million general fund dollars.

The fiscal note attached to the bill included the $3.1 million price tag and revenues of $10.2 million. This figure comes from an economic report by Randall Sell and Larry Leistritz of the NDSU Department of Agricultural Economics, completed in December of 1998, that applied the most recent scientific evaluations of the North Dakota's current cloud seeding program's efficacy statewide to eight common North Dakota crops. The results of the study showed that by reducing crop hail damage by 45% and increasing rainfall by approximately 10% statewide, an additional $267 million in total added business volume would be created annually generating $5.1 million in additional general fund tax revenues annually. Despite these factors, the House Agriculture committee declined to pass the bill.

An amendment was then offered with two basic purposes. The intent of the amendment was to clarify N.D.C.C. Chapter 61 as to the ability of private individuals or associations in geographically contiguous areas to contract with the Board to conduct cloud seeding operations, and to allow the Board to plan and study a hail suppression pilot program that would provide urban and rural hail suppression operations statewide or to any portion of the state. No additional funding, however, was appropriated by the House Agriculture committee to conduct further planning. The Board's appropriation bill, which is a part of the State Water Commission bill, does not include the funds to accomplish this goal either.

The statewide planning process is twofold: to conduct an environmental impact study (EIS), and convene committees of national experts in cloud seeding hypothesis assessment and operations safeguards to formulate an operations plan. But, without increased funding this process will be unable to go forward. Because of funding issues in the past, the hypothesis assessment and operations safeguards committees have not been convened since the mid 1980's and lack of an EIS has, since 1991, precluded North Dakota's western counties currently in the program from obtaining permission from Montana to seed over their airspace to affect storms as they enter western North Dakota. This has hurt the efficacy of the program over the western portions of those counties bordering Montana and quite possibly precluded other western North Dakota counties from joining the program.

Economic Impact of Reducing Hail and Enhancing Rainfall in North Dakota

An economic evaluation of the benefits and potential benefits of hail suppression and rain enhancement efforts through cloud seeding in North Dakota. The study projects impacts on eight common crops and actual cropping practices for the period 1988 - 1997.

by

Randall S. Sell

and

F. Larry Leistritz

December 1998

HIGHLIGHTS

North Dakota producers experience substantial losses to farm output and fixed assets because of hail. The North Dakota Cloud Modification Project (NDCMP) has actively practiced cloud modification in five or six counties in western North Dakota during the past 10 years. A recent study concluded that crop-hail damage in the cloud modification counties was reduced by 45 percent for the wheat, barley, oats, corn, sunflower, and flax. Another impact of the cloud modification project is enhanced rainfall. Enhanced rainfall does not always benefit all producers, depending on the subsequent impacts on yield, quality, and price. The economic impact to the state of enhanced rainfall is also estimated. The crops used in estimating the combined impacts of hail reduction and rainfall enhancement were wheat, barley, oats, sunflower, corn, flax, soybeans, and dry edible beans.

Estimates of crop-hail losses and crop losses prevented with cloud modification for all counties were based upon crop production and hail data from 1988 to 1997. These estimates required multiplying the county level gross values of production by its annual loss-cost ratio to get the expected hail loss and then multiplying the expected loss by the 45 percent reduction factor to estimate the crop output savable with cloud modification. Slightly different equations were necessary depending on whether the county had an on-going cloud modification project in place.

Changes in crop production due to increased rainfall were determined. The effects of increased wheat production on price received were considered. A change in crop production was estimated by changing yields per acre, not acres of crop harvested.

The direct impact of hail reduction was $34 million and the direct impact of rainfall enhancement was $52 million statewide, which resulted in a total direct impact of nearly $87 million annually. This direct impact results in an increase in total business activity of $267 million or an average $14.52 per planted acre. Seventy-five percent of the total economic impact occurred in two sectors of the economy, 'households' and 'retail trade.' Pembina County is projected to experience a slight negative impact from the additional rainfall (-$0.28 per planted acre), but this is more than offset by the projected benefits from hail suppression activities (+$3.05 per planted acre). All other counties are expected to be positive in both categories. Total impacts were generally greater in the eastern one-half of North Dakota while the impacts as a percentage of gross receipts were greater in western North Dakota.

The estimated annual cost of operating the NDCMP statewide was $3.2 million. Increased state tax revenue from sales and use tax, personal income tax, and corporate income tax as a result of the program was $5.1 million annually. Thus, the increased state tax revenue would substantially exceed the cost of the program.

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Economic Impact of Reducing Hail and Enhancing Rainfall in North Dakota

Randall S. Sell and F. Larry Leistritz

INTRODUCTION

The North Dakota Atmospheric Resource Board (NDARB) is concerned about agricultural and nonagricultural losses due to hail. The NDARB (formerly known as the North Dakota Weather Modification Board) has been responsible for administrative oversight and conduct of the North Dakota Cloud Modification Project (NDCMP) since 1976, in cooperation with the participating counties. Cloud seeding efforts have been conducted in the state in a less-structured form since 1961. North Dakota typically experiences some of the highest insurance dollar losses to crops among all states in the United States (Changnon 1977, 1984). Furthermore, an area in southwestern North Dakota has the highest ratio of damage claims paid to insured crop liability (Miller and Fuhs 1987).

The objective of this study was to determine the economic impact of cloud seeding effects for the state of North Dakota. This study represents an attempt to quantify the benefits of hail suppression and rain enhancement for eight grain crops produced in North Dakota. The economic impact of hail reduction for the state was last estimated at $97.8 million annually using the crop production and hail loss ratios from 1976 to 1985 (Johnson et al. 1989). The economic impact of enhanced rainfall and changing the crop/livestock mix within the state was estimated at $676.9 million using crop and livestock prices and production averages from 1977 to 1981 (Schaffner et al. 1983).

METHODS

Determining the economic impact of cloud seeding efforts in North Dakota was accomplished in two parts 1) the economic impact of crop-hail reduction and 2) the economic impact of enhanced rainfall. The economic impact of crop-hail reduction predominantly followed the methodology established previously by Johnson et al. (1989) as follows: 1) calculate crop-hail loss-cost ratios by counties for 10 years, 2) compute gross values of production for each of the six crops used in the Smith et al. (1997) study for the years 1988-1997 using the North Dakota Tax Assessment Model data set (Vruegdenhil 1998), 3) multiply county loss-cost ratios times county values of crop production to measure county value of crop production (crop sales) lost each year due to hail, 4) multiply the county value of production lost by the Smith et al. (1997) reduction factor (0.45) to determine the crop output potentially savable through cloud seeding for hail suppression, 5) apply multipliers to measure what the value of crop output savable would mean to community and state economies, and 6) divide findings by total acres of the crops in each county to provide a common per-acre base for the analysis.

Some changes were made to the Johnson et al. (1989) methodology. Two additional crops were included (soybeans and dry edible beans). These crops were included because the cropping patterns have changed and soybeans and dry edible beans have surpassed several of the original crops included in the previous studies (Table 1). Although not included, canola has recently become an important crop to North Dakota; it displaced oats and flax in amount of harvested acres in 1997. The other change was a slight modification of the Smith et al. (1997)

reduction factor as applied to soybeans and dry edible beans, as these crops were not included among the crops used in arriving at the 0.45 damage reduction factor. The economic impact was only estimated for the eight crops included in the study (i.e., no other cash crops or forage crops were included in the estimate). Also, the impact of decreased property hail-loss was not included.

Table 1. Harvested Acres of Top Eleven Crops in North Dakota in 1988 and 1997

Crop	1988	Rank	1997	Rank
	- 000 -		- 000 -	
Wheat	7,230	1	11,025	1
Barley	2,150	2	2,250	2
Sunflower	1,410	3	1,410	3
Soybeans	690	4	1,190	4
Oats	400	5	400	8
Corn grain	380	6	605	5
Dry edible beans	370	7	530	6
Flax	185	8	110	10
Sugar beets	176	9	228	9
Potatoes	135	10	105	11
Canola	na	-	480	7

Source: North Dakota Agricultural Statistics Service (1989, 1998)

The steps used to calculate the economic impact of enhanced rainfall were as follows: 1) compute the gross value of production for all crops included in the study for 1988 to 1997, 2) increase the yields for each of the crops included in the study according to Schaffner et al. (1983), 3) calculate the increased supply for all wheat for the state of North Dakota, 4) calculate a 'new' average price for all wheat using the estimated 'flexibility' coefficient from Johnson et al. (1998), 4) compute the gross value of production for all crops using the increased crop yields and decreased all wheat price (other crop prices were not changed), 5) subtract the base value for

each county from the gross value of production with increased crop yields to determine the impact of enhanced rainfall, 6) apply multipliers to measure what the value of enhanced crop output would mean to community and state economies, 7) divide findings by total planted acres of the crops in each county to provide a common per-acre base for the analysis, and 8) calculation of additional potential revenue to the state general fund.

The six crops used in previous analysis (Johnson et al. 1989) and the crops used to determine the Smith et al. (1997) reduction factor were all wheat, all barley, oats, all sunflower, corn grain, and flax. To more accurately reflect the current cropping practices in North Dakota, soybeans and dry edible beans were included to estimate the impact of NDCMP. To be conservative it was assumed that the crop-hail reduction factor for soybeans and dry edible beans would be less than the Smith et al. (1997) reduction factor. The reduction factor for soybeans and dry edible beans was assumed to be 0.30 as opposed to the 0.45 calculated for the original six crops. The Smith et al. (1997) reduction factor was modified based upon the 10-year average proportion of soybeans and dry edible beans to the total planted acres of the original six crops. The state average adjusted reduction factor was 0.43. This adjusted reduction factor ranged from a high of 0.45 for six counties which had an average total of soybeans and dry edible beans of less than 100 acres to a low of 0.40 for Richland County. Richland County had an average of 34 percent of its planted acres in soybeans and dry edible beans.

Not all counties which had participated in the NDCMP from 1988 to 1997 did so on a continual basis (Table 2). McKenzie, Mountrail, and Ward Counties did participate every year.

Bowman and Slope Counties participated every year except 1990. Therefore 1990 average hail loss-cost data for Bowman and Slope Counties was not used. Hettinger and Williams Counties each participated one year; therefore, these counties were not included as treated counties and the average hail loss-cost data was not included for the year that each county did participate in the program. Those counties which were included in the analysis as treated counties are shown in Figure 1.

Table 2. North Dakota Cloud Modification Project Treated Counties from 1988 through 1997

Counties	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Bowman	X	X	O	X	X	X	X	X	X	X
Hettinger	X	O	O	O	O	O	O	O	O	O
McKenzie	X	X	X	X	X	X	X	X	X	X
Mountrail	X	X	X	X	X	X	X	X	X	X
Slope	X	X	O	X	X	X	X	X	X	X
Ward	X	X	X	X	X	X	X	X	X	X
Williams	O	O	O	O	O	O	O	O	O	X

Note: X means cloud seeding practiced, O means no cloud seeding practiced

The NDARB estimated the total cost of operating the NDCMP was $0.08 per acre for the total targeted land area in 1998 (Boe 1998). Assuming some economies of scale, the cost to operate the NDCMP statewide would be about $0.07 per acre. North Dakota's total land area is 45.249 million acres, which means the cost of operating the program statewide would be approximately $3.2 million.

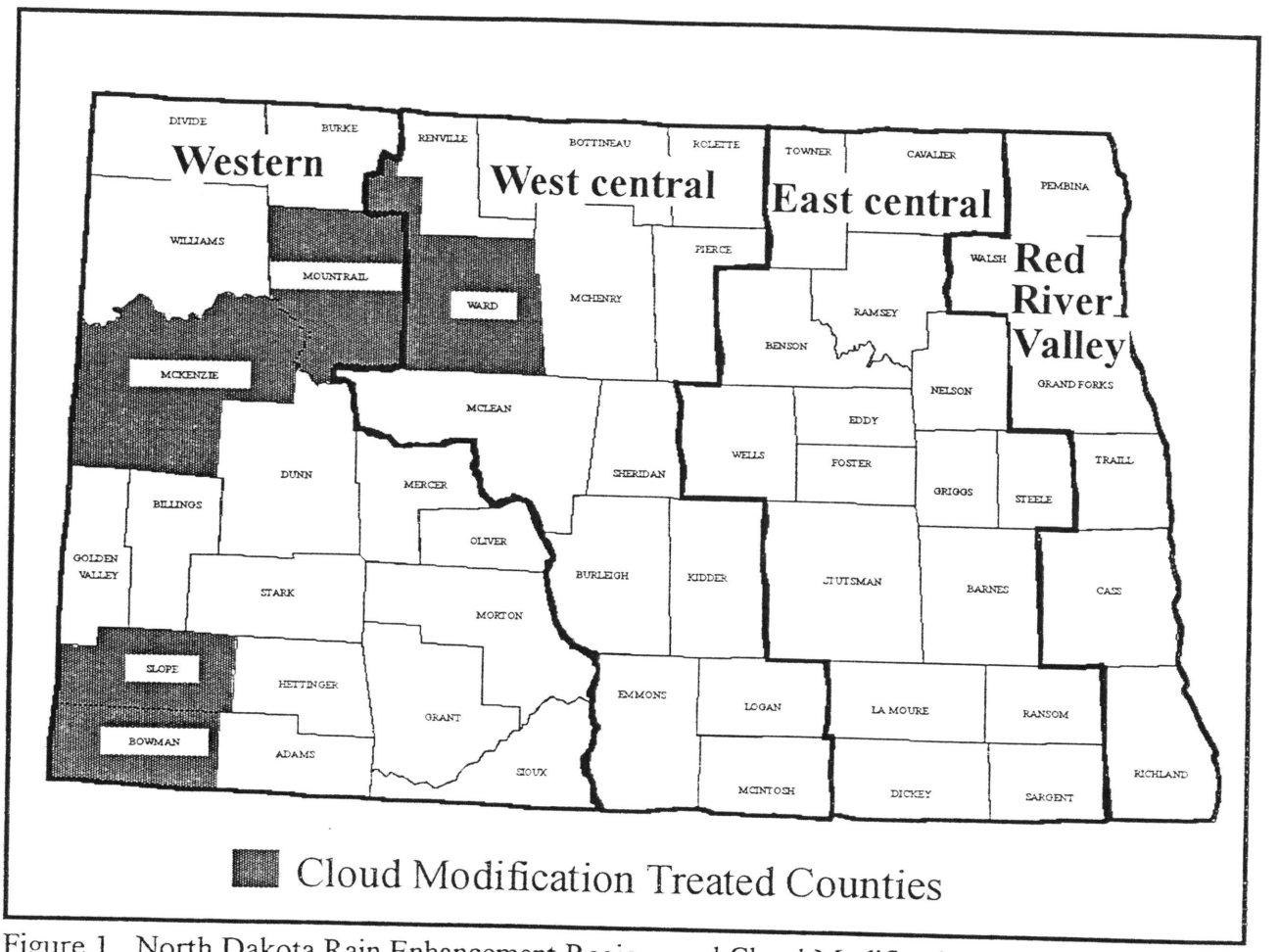

Figure 1. North Dakota Rain Enhancement Regions and Cloud Modification Treated Counties

Crop-hail loss-cost ratios for each county, year, and crop included in the study was used to develop a 10-year weighted loss-cost ratio for each county (National Crop Insurance Services 1988-1997). The loss-cost ratio is the total dollar losses due to hail divided by the total dollars of insured liability times 100. This ratio is calculated for a specified area (county) and crop, and it represents the dollars of loss per $100 liability resulting from hail damages to an insured crop.

Steps to Determine Hail Reduction Impact

Calculation of the gross values of production for each of the eight crops was accomplished using the North Dakota Tax Assessment Model data set from 1988 to 1997. This model used marketing year prices for each crop by crop reporting district. County average yields, planted and harvested acres by crop were also used to determine gross returns per planted acre and per county for all crops (North Dakota Agricultural Statistics Service 1989-1998).

To determine the possible crop sales lost due to hail the county loss-cost ratios were multiplied by the county values of crop production. These values were calculated on a year by year basis and then averaged across the ten-year period.

Possible crop output savable due to cloud modification involved multiplying the county value of crop production lost to hail by the adjusted Smith et al. (1997) reduction factor for each county. This value results in the direct economic impact of hail suppression attributed to successful cloud modification. It was necessary to use separate equations for the treated and non-treated counties. The equations for each are shown below.

1) Potential annual crop output savable due to cloud seeding in each non-treated county is defined as:

Average County Value of Crop Production

x

Average County Loss-cost Ratio

x

County Adjusted Reduction Factor

This value represents the average annual amount of crop losses which would not have been lost to hail if the hail suppression efforts had achieved the level reported by Smith et al. (1997).

2) Potential annual crop output savable due to cloud seeding in each treated county is defined as:

[(*Average County Value of Crop Production* x *Loss-cost Ratio*)
/ (*1.0 - County Adjusted Reduction Factor*)]
minus (*Average County Value of Crop production* x *Loss-cost Ratio*)

The total crop output savable because of the suppression of hail results are then used in the North Dakota Input-Output model (Coon et al. 1985) to determine the total economic impact for each county and for the state. The overall economic impact is the result of the total value of crop output savable plus the indirect and induced changes which result from those losses not occurring. The overall economic impact for the state is then divided by all acres planted to the eight crops within each county to provide a common per-acre base for analysis.

Steps to Determine Rain Enhancement Impact

Gross value of production was the same calculation for rain enhancement impact as for the hail reduction impact. Yields were changed for each crop based on the enhanced rainfall (Schaffner et al. 1983). Yield changes for dry edible beans were not available; therefore, dry edible beans yields were not changed (Table 3). Soybeans were produced in all four regions of the state; however, increased yields were only available for the Red River Valley region of the state.

Increased supply of wheat was determined each year, and the rain enhanced supply was compared to the original supply to determine the percentage increase in wheat supply for each year. The percentage increase in wheat supply was used to adjust the wheat price by crop

reporting district using an estimated 'flexibility' coefficient of 0.856 (Johnson et al. 1998). Essentially this coefficient means that for every one percent change in the supply of wheat, the price of wheat can be expected to change by 0.856 percent in the opposite direction. The estimated coefficient was calculated for hard red spring wheat using the Minneapolis Grain Exchange nearby futures market. Flexibility coefficients for the other North Dakota crops were not available. North Dakota's total production of corn and soybeans is just a small fraction of total United States production, and a small increase per acre on relatively few acres would not likely have a significant impact on price. However, North Dakota is an important producer of the United States' total production of barley, oats, flax, and sunflower. If 'flexibility' coefficients were available for these crops, then their use in this study would likely be warranted.

The final steps in calculating the impact of increased rainfall involved computing the gross value of production for all crops using the increased crop yields and decreased wheat price (other crop prices were not changed) and subtracting the original base value for each county. Next, the North Dakota Input-Output model was used to determine what the value of enhanced rainfall would mean to communities and state economies. The last step was to divide the direct and total impacts by the total planted acres of the crops in each county to provide a common annual per-acre base for the comparison.

Table 3. Average Yield Increase Per Harvested Acre Due to Growing Season Rainfall in Four Regions of North Dakota

	Western	West Central	East Central	Red River Valley
June-July increased rainfall (inches)	0.83	0.82	0.81	0.80
June-Aug. increased rainfall (inches)	1.15	1.17	1.16	1.13
Wheat (bu/acre) [a]	2.25	2.2	1.7	1.4
Barley (bu/acre) [a]	2.08	2.3	2.4	2.0
Oats (bu/acre) [a]	2.91	4.1	3.2	2.4
Flax (bu/acre) [a]	0.5	1.6	1.3	1.0
Corn Grain (bu/acre) [b]	3.17	4.1	3.5	2.8
Sunflower (lbs/acre) [b]	156	158	139	136
Soybeans (bu/acre) [b]	c	c	c	1.7
Dry Edible Beans (hdwt/acre)	c	c	c	c

Source: Schaffner et al. (1983)
[a] June-July added rainfall was used in calculating yield increase.
[b] June-August added rainfall was used in calculating yield increase.
c Not available

RESULTS

Ten-year annual average crop-hail loss-ratios for all the eight crops considered in this study reveal that loss ratios ranged from a high of 10.27 in Sioux County to a low of 2.12 in Grand Forks County (Table 4). The annual values of crop production for all eight crops were calculated for each of the 10 years, 1988-1997, for each county. The 10-year average crop yields and prices are shown in Appendix A.

The 10-year average gross returns per acre were greatest for Richland and Cass Counties and lowest for Grant and Sioux Counties (Table 5). A comparison of the gross returns from the eight crops considered to all crops grown in each county reveals that the eight crops generally represent about 80 percent of gross returns for all crops. Comparing total harvested acres of the

individual crops revealed that 63 percent of harvested acres were wheat followed by barley, sunflower, soybeans, dry edible beans, corn grain, oats, and flax with 15, 8, 4, 3, 3, 3, and 1, percent, respectively (Table 6).

The greatest annual crop output savable per acre, for the crops included in the study, occurs in Golden Valley County, and the least in Stark County (Table 7). The ten-year average crop output savable per acre to North Dakota was $1.87. The lowest direct impact for a county occurred in Billings County and the highest was in Cavalier County. The total direct impact (crop output savable because of hail reduction) to the state was $34.4 million. This resulted in a total impact of hail reduction of $106 million for the crops included in the study.

The direct impact of enhanced rainfall to the state of North Dakota, for the crops included in the study, was $52.2 million which resulted in a total impact of $160.7 million (Table 8). The largest direct impact was in Cass County followed closely by Richland County. Richland County also had the highest dollar/acre of direct impact ($4.73/acre). Increased rainfall did not always translate into increased gross returns to a county. Pembina County gross returns declined by $117,000 in the enhanced rainfall scenario.

Total direct impacts of hail reduction and rainfall enhancement amounted to nearly $87 million annually statewide for the eight crops (Table 9). The impacts tended to be greater in eastern North Dakota, with the leading four counties (Cass, Richland, Stutsman, and Barnes) accounting for nearly 20 percent of the total direct impact. Richland County also had the greatest

per acre direct impact of $6.69. Other counties which had a total direct impact of more than $6/planted acre were Pierce, Nelson, Ramsey, Eddy, and Foster Counties. The state average total direct impact was $4.72/planted acre. Counties which had the highest direct impacts of hail reduction and rain enhancement as a percentage of gross receipts were Sioux, Emmons, McIntosh, and Pierce Counties. All four of these counties had an increase in gross receipts of more than 7.5 percent. The average increase in gross receipts to the state was 4.5 percent.

The total economic impact of hail reduction and enhanced rainfall for the eight crops included in the study by economic sector reveals the greatest impact was to the *household* sector which represented about 50 percent of the total impact (Table 10). The *retail trade* sector also experienced a large share of total economic impact (25 %).

The increase in state tax revenues more than offset the expected cost of operating the program (Table 11). As mentioned previously, the NDCMP would cost about $3.2 million to operate statewide. The increase in sales and use tax, personal and corporate income tax was estimated to be $5.1 million.

Table 4. Ten-Year Average Loss-Cost Ratios by Counties, 1988-1997

County	Liability	Loss	Loss-Cost Ratio
Adams	$2,297,000	$152,600	6.64%
Barnes	19,566,500	453,500	2.32%
Benson	14,901,600	975,600	6.55%
Billings	540,100	24,100	4.46%
Bottineau	19,907,400	911,300	4.58%
Bowman	1,952,111	109,889	5.63%
Burke	4,044,400	237,800	5.88%
Burleigh	3,566,100	189,400	5.31%
Cass	44,783,700	1,063,400	2.37%
Cavalier	25,535,500	1,335,100	5.23%
Dickey	10,441,900	274,900	2.63%
Divide	2,024,200	86,700	4.28%
Dunn	1,927,600	71,000	3.68%
Eddy	4,381,200	209,100	4.77%
Emmons	4,767,400	461,500	9.68%
Foster	9,270,400	396,700	4.28%
Golden Valley	1,630,800	147,500	9.04%
Grand Forks	29,609,500	627,400	2.12%
Grant	1,824,600	94,100	5.16%
Griggs	7,762,000	314,600	4.05%
Hettinger	8,633,333	526,889	6.10%
Kidder	3,035,300	135,600	4.47%
LaMoure	11,512,100	438,100	3.81%
Logan	1,529,400	92,700	6.06%
McHenry	6,978,100	299,100	4.29%
McIntosh	1,668,100	118,100	7.08%
McKenzie	4,747,000	236,300	4.98%
McLean	9,793,700	264,600	2.70%
Mercer	1,339,700	73,900	5.52%
Morton	4,121,600	160,700	3.90%
Mountrail	9,397,200	289,800	3.08%
Nelson	17,338,400	983,700	5.67%
Oliver	1,323,000	54,200	4.10%
Pembina	18,684,700	1,164,700	6.23%
Pierce	8,913,100	582,800	6.54%
Ramsey	20,160,000	1,339,600	6.64%
Ransom	13,085,800	295,800	2.26%
Renville	11,385,900	519,000	4.56%
Richland	39,986,500	1,250,900	3.13%
Rolette	6,943,000	428,200	6.17%
Sargent	14,049,700	488,100	3.47%
Sheridan	3,866,600	138,300	3.58%

------- continued -------

Table 4. Continued

County	Liability	Loss	Loss-Cost Ratio
Sioux	$660,400	$67,800	10.27%
Slope	2,174,222	81,000	3.73%
Stark	2,697,500	71,200	2.64%
Steele	17,289,300	680,800	3.94%
Stutsman	14,104,800	618,000	4.38%
Towner	16,062,200	802,500	5.00%
Traill	23,572,500	568,100	2.41%
Walsh	28,459,700	814,600	2.86%
Ward	14,772,500	617,200	4.18%
Wells	14,571,700	405,600	2.78%
Williams	7,339,800	512,800	6.99%

Table 5. Average Annual Gross Returns Per County for All Crops and Eight Crops Used in Analysis (1988-1997)

County	Gross Returns Eight Crops		Gross Returns All Crops		Proportion of All Crops to Eight Crops Gross Returns
	— $ —	$/plnted acre	— $ —	$/plnted acre	
Adams	12,164,348	71.09	17,268,252	53.41	70.44%
Barnes	76,946,337	118.14	80,428,071	109.89	95.67%
Benson	41,150,790	92.45	44,668,738	75.60	92.12%
Billings	3,310,012	61.09	7,569,568	50.93	43.73%
Bottineau	59,562,354	102.20	62,629,762	83.35	95.10%
Bowman	11,060,760	79.25	14,824,937	53.22	74.61%
Burke	26,286,444	100.80	28,309,601	69.05	92.85%
Burleigh	15,902,202	65.97	24,826,200	59.91	64.05%
Cass	131,172,052	142.53	150,288,031	149.59	87.28%
Cavalier	66,452,789	98.74	67,209,407	86.82	98.87%
Dickey	40,854,343	122.15	47,901,824	113.30	85.29%
Divide	28,525,476	103.02	30,807,151	63.00	92.59%
Dunn	13,901,119	64.23	24,201,914	55.04	57.44%
Eddy	16,022,173	91.70	19,469,356	82.32	82.29%
Emmons	20,806,778	63.35	30,416,648	63.38	68.41%
Foster	26,974,066	104.90	30,185,841	99.85	89.36%
Golden Valley	10,339,820	82.98	12,018,483	59.85	86.03%
Grand Forks	82,850,204	136.09	125,141,663	175.56	66.21%
Grant	14,223,185	58.71	22,412,113	51.06	63.46%
Griggs	28,211,923	109.44	31,735,142	103.22	88.90%
Hettinger	27,926,425	90.39	32,339,061	65.13	86.36%
Kidder	10,009,090	67.76	23,450,315	71.53	42.68%
LaMoure	51,489,156	116.85	56,947,184	106.68	90.42%
Logan	13,882,004	74.76	20,423,486	67.12	67.97%
McHenry	29,306,736	85.57	41,153,754	71.17	71.21%
McIntosh	15,390,670	66.84	21,335,603	61.70	72.14%
McKenzie	19,492,673	86.13	34,024,372	75.06	57.29%
McLean	54,800,489	98.05	60,151,144	74.98	91.10%
Mercer	10,700,090	75.36	16,394,518	60.79	65.27%
Morton	18,551,252	61.14	31,309,903	59.58	59.25%
Mountrail	38,017,256	104.58	42,164,072	69.89	90.17%
Nelson	38,010,457	102.62	40,100,236	92.23	94.79%
Oliver	8,168,037	72.19	12,573,061	68.01	64.96%
Pembina	55,291,147	124.36	120,533,083	207.71	45.87%
Pierce	25,081,594	84.56	28,701,900	69.27	87.39%
Ramsey	46,550,546	96.88	47,766,518	85.36	97.45%
Ransom	40,297,726	137.77	47,175,853	137.23	85.42%
Renville	38,480,695	106.65	39,416,874	82.89	97.62%
Richland	106,752,561	156.78	130,171,817	171.82	82.01%
Rolette	20,830,129	94.67	25,020,607	78.17	83.25%
Sargent	40,981,071	132.91	47,086,083	132.88	87.03%
Sheridan	16,850,834	79.22	20,200,692	63.75	83.42%
Sioux	3,327,994	50.12	8,332,331	50.07	39.94%
Slope	11,781,711	86.94	15,092,095	55.79	78.07%
Stark	20,805,762	73.88	29,131,929	57.89	71.42%
Steele	46,057,181	130.81	47,994,820	125.32	95.96%
Stutsman	66,570,698	100.45	75,405,523	89.32	88.28%
Towner	37,897,242	92.24	41,870,665	82.17	90.51%
Traill	62,776,271	145.01	90,470,806	182.32	69.39%
Walsh	60,511,617	122.10	127,740,550	195.75	47.37%
Ward	65,713,658	103.64	70,608,701	80.89	93.07%
Wells	49,922,977	103.32	52,926,213	88.89	94.33%
Williams	37,914,060	90.29	45,679,479	57.49	83.00%
Total	$1,916,856,984	$104.37	$2,416,005,952	$94.64	79.34%

Table 6. Ten-Year Average Harvested Acres by Crop and County, 1988-1997

	Wheat	Barley	Oats	All Sunflower	Flax	Corn grain	Soybeans	Beans	Total
Adams	117,080	13,600	7,590	2,580	230	710	0	110	141,900
Barnes	337,310	120,120	6,300	122,880	3,940	9,680	18,570	2,600	621,400
Benson	260,980	80,110	9,790	44,510	4,880	2,940	830	4,010	408,050
Billings	30,790	3,660	5,950	310	30	100	0	0	40,840
Bottineau	383,430	132,850	14,340	24,830	8,490	530	640	560	565,670
Bowman	97,680	13,470	5,850	1,390	150	390	10	140	119,080
Burke	195,280	30,910	8,790	9,670	3,520	130	70	120	248,490
Burleigh	145,470	12,380	16,570	5,900	2,020	3,110	240	1,360	187,050
Cass	384,180	113,580	3,720	65,260	440	69,240	220,680	25,900	883,000
Cavalier	414,150	172,650	4,720	21,830	10,180	170	580	4,840	629,120
Dickey	146,790	24,960	10,510	55,380	1,720	51,020	6,490	8,570	305,440
Divide	230,350	20,700	6,920	3,230	1,620	0	10	40	262,870
Dunn	118,440	20,380	17,380	1,490	110	500	0	10	158,310
Eddy	92,490	16,590	7,940	33,790	2,710	2,850	770	2,590	159,730
Emmons	181,160	19,940	21,780	8,780	3,120	3,940	340	850	239,910
Foster	145,020	21,210	6,340	59,980	3,260	4,310	1,550	1,300	242,970
Golden Valley	84,390	15,390	6,520	470	380	520	10	10	107,690
Grand Forks	274,460	115,390	3,140	34,650	730	15,240	41,330	96,960	581,900
Grant	129,950	21,800	16,810	8,550	520	3,460	10	800	181,900
Griggs	132,270	55,650	4,200	31,540	2,340	2,360	4,350	10,510	243,220
Hettinger	239,450	21,290	10,580	5,680	2,150	450	120	1,550	281,270
Kidder	73,400	11,040	13,660	3,830	3,500	4,440	650	620	111,140
LaMoure	221,860	38,100	10,530	93,440	3,970	22,240	10,140	9,650	409,930
Logan	112,260	18,930	8,940	9,110	2,660	1,400	90	0	153,390
McHenry	200,910	46,900	22,630	35,720	5,480	2,900	0	440	314,980
McIntosh	136,640	16,350	20,080	13,690	4,900	990	460	50	193,160
McKenzie	160,660	17,830	7,010	740	110	810	0	930	188,090
McLean	402,350	48,090	25,260	22,380	9,360	2,530	140	15,740	525,850
Mercer	90,850	7,410	13,260	1,750	360	420	10	140	114,200
Morton	152,460	33,110	19,610	7,800	470	3,210	10	40	216,710
Mountrail	295,890	27,440	11,110	8,480	2,140	170	80	280	345,590
Nelson	212,490	70,750	5,010	51,560	3,470	1,330	3,660	5,630	353,900
Oliver	58,350	12,970	10,390	3,480	960	1,160	0	1,810	89,120
Pembina	268,230	69,380	1,940	9,780	1,070	5,520	6,990	49,830	412,740
Pierce	172,650	48,850	11,450	28,310	4,760	1,450	70	510	268,050
Ramsey	276,610	102,240	3,480	50,000	9,010	730	1,050	7,070	450,190
Ransom	119,030	27,490	5,550	41,490	230	50,180	15,610	12,810	272,390
Renville	241,070	82,790	9,600	12,640	5,830	200	10	30	352,170
Richland	209,190	23,840	4,290	33,930	310	154,340	214,830	13,210	653,940
Rolette	135,370	55,900	6,290	8,030	2,610	380	190	100	208,870
Sargent	129,930	22,850	3,900	31,180	360	45,430	46,600	7,960	288,210
Sheridan	128,700	27,270	9,150	23,690	3,730	1,070	160	360	194,130
Sioux	34,450	2,880	5,630	690	140	300	250	0	44,340
Slope	101,800	14,670	4,640	1,560	110	190	0	130	123,100
Stark	187,100	25,200	19,370	2,590	250	700	0	110	235,320
Steele	164,060	70,570	1,330	24,510	1,570	7,810	21,120	44,900	335,870
Stutsman	380,010	64,930	14,920	121,860	9,170	9,810	3,530	6,260	610,490
Towner	269,230	89,760	2,710	18,100	6,810	160	690	4,420	391,880
Traill	180,570	88,790	950	13,700	60	15,800	67,440	51,370	418,680
Walsh	305,390	71,240	3,900	23,330	1,610	4,270	3,930	52,670	466,340
Ward	451,150	88,220	24,680	30,760	12,750	1,300	90	380	609,330
Wells	274,750	63,640	9,590	75,240	3,630	5,770	1,170	20,760	454,550
Williams	357,550	26,560	9,400	1,780	540	210	0	260	396,300
Total	10,646,080	2,462,620	516,000	1,347,850	154,470	518,870	695,570	471,300	16,812,760
Relative share	63%	15%	3%	8%	1%	3%	4%	3%	100%

Table 7. Annual Average Crop Output Savable Due to Hail Reduction

County	Direct Impact	Total Bus. Activity	Direct Impact per planted acre	Total Bus. Activity per planted acre
Adams	$363,567	$1,119,153	$2.12	$6.54
Barnes	793,361	2,442,167	1.22	3.75
Benson	1,207,334	3,716,483	2.71	8.35
Billings	66,464	204,592	1.23	3.78
Bottineau	1,226,092	3,774,225	2.10	6.48
Bowman	228,889	704,578	1.64	5.05
Burke	695,312	2,140,349	2.67	8.21
Burleigh	379,070	1,166,875	1.57	4.84
Cass	1,270,162	3,909,882	1.38	4.25
Cavalier	1,558,472	4,797,377	2.32	7.13
Dickey	476,220	1,465,926	1.42	4.38
Divide	549,762	1,692,307	1.99	6.11
Dunn	230,408	709,254	1.06	3.28
Eddy	341,692	1,051,816	1.96	6.02
Emmons	905,132	2,786,228	2.76	8.48
Foster	517,331	1,592,476	2.01	6.19
Golden Valley	420,806	1,295,349	3.38	10.40
Grand Forks	724,500	2,230,197	1.19	3.66
Grant	329,585	1,014,547	1.36	4.19
Griggs	503,435	1,549,702	1.95	6.01
Hettinger	765,066	2,355,068	2.48	7.62
Kidder	200,600	617,497	1.36	4.18
LaMoure	867,886	2,671,575	1.97	6.06
Logan	378,576	1,165,354	2.04	6.28
McHenry	564,994	1,739,195	1.65	5.08
McIntosh	489,964	1,508,236	2.13	6.55
McKenzie	355,612	1,094,665	1.57	4.84
McLean	659,340	2,029,618	1.18	3.63
Mercer	265,506	817,294	1.87	5.76
Morton	325,456	1,001,838	1.07	3.30
Mountrail	431,171	1,327,254	1.19	3.65
Nelson	961,594	2,960,034	2.60	7.99
Oliver	149,685	460,768	1.32	4.07
Pembina	1,475,270	4,541,260	3.32	10.21
Pierce	737,489	2,270,181	2.49	7.65
Ramsey	1,382,665	4,256,195	2.88	8.86
Ransom	396,127	1,219,381	1.35	4.17
Renville	789,295	2,429,652	2.19	6.73
Richland	1,330,198	4,094,690	1.95	6.01
Rolette	577,777	1,778,546	2.63	8.08
Sargent	601,736	1,852,298	1.95	6.01
Sheridan	270,955	834,070	1.27	3.92
Sioux	153,527	472,596	2.31	7.12
Slope	161,425	496,907	1.19	3.67
Stark	247,080	760,575	0.88	2.70

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Table 7. Continued

County	Direct Impact	Total Bus. Activity	Direct Impact per planted acre	Total Bus. Activity per planted acre
Steele	$760,948	$2,342,393	$2.16	$6.65
Stutsman	1,305,464	4,018,551	1.97	6.06
Towner	847,823	2,609,818	2.06	6.35
Traill	614,943	1,892,952	1.42	4.37
Walsh	746,740	2,298,657	1.51	4.64
Ward	1,010,094	3,109,327	1.59	4.90
Wells	615,193	1,893,721	1.27	3.92
Williams	1,191,698	3,668,352	2.84	8.74
Total	$34,419,492	$105,952,000	$1.87	$5.77

Table 8. Annual Average Increased Gross Returns Due to Enhanced Rainfall

County	Direct Impact	Total Bus. Activity	Direct Impact per planted acre	Total Bus. Activity per planted acre
Adams	$439,040	$1,351,496	$2.57	$7.90
Barnes	2,610,095	8,034,656	4.01	12.34
Benson	1,180,905	3,635,182	2.65	8.17
Billings	124,512	383,287	2.30	7.07
Bottineau	1,722,522	5,302,441	2.96	9.10
Bowman	319,814	984,483	2.29	7.05
Burke	662,041	2,037,962	2.54	7.81
Burleigh	700,347	2,155,879	2.91	8.94
Cass	3,318,368	10,214,933	3.61	11.10
Cavalier	1,224,097	3,768,139	1.82	5.60
Dickey	1,332,877	4,102,997	3.99	12.27
Divide	648,317	1,995,715	2.34	7.21
Dunn	461,976	1,422,102	2.13	6.57
Eddy	722,246	2,223,291	4.13	12.72
Emmons	940,372	2,894,748	2.86	8.81
Foster	1,080,528	3,326,190	4.20	12.94
Golden Valley	291,289	896,675	2.34	7.20
Grand Forks	777,459	2,393,254	1.28	3.93
Grant	743,258	2,287,972	3.07	9.44
Griggs	860,385	2,648,524	3.34	10.27
Hettinger	656,032	2,019,464	2.12	6.54
Kidder	468,093	1,440,932	3.17	9.76
LaMoure	1,664,181	5,122,848	3.78	11.63
Logan	606,481	1,866,931	3.27	10.05
McHenry	1,364,821	4,201,330	3.98	12.27
McIntosh	870,493	2,679,639	3.78	11.64
McKenzie	448,997	1,382,148	1.98	6.11
McLean	1,610,522	4,957,671	2.88	8.87
Mercer	308,903	950,897	2.18	6.70
Morton	789,342	2,429,833	2.60	8.01
Mountrail	959,663	2,954,132	2.64	8.13
Nelson	1,272,572	3,917,358	3.44	10.58
Oliver	298,495	918,857	2.64	8.12
Pembina	(117,342)	(361,212)	(0.26)	(0.81)
Pierce	1,171,013	3,604,730	3.95	12.15
Ramsey	1,534,141	4,722,546	3.19	9.83
Ransom	1,048,173	3,226,591	3.58	11.03
Renville	1,021,616	3,144,842	2.83	8.72
Richland	3,222,433	9,919,618	4.73	14.57
Rolette	722,318	2,223,511	3.28	10.11
Sargent	839,457	2,584,099	2.72	8.38
Sheridan	909,837	2,800,750	4.28	13.17
Sioux	166,736	513,262	2.51	7.73
Slope	311,796	959,803	2.30	7.08

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Table 8. Continued

County	Direct Impact	Total Bus. Activity	Direct Impact per planted acre	Total Bus. Activity per planted acre
Stark	$679,613	$2,092,053	$2.41	$7.43
Steele	739,309	2,275,814	2.10	6.46
Stutsman	2,207,412	6,795,077	3.33	10.25
Towner	883,218	2,718,811	2.15	6.62
Traill	948,492	2,919,744	2.19	6.74
Walsh	9,340	28,750	0.02	0.06
Ward	1,847,832	5,688,181	2.91	8.97
Wells	1,498,181	4,611,850	3.10	9.54
Williams	1,086,383	3,344,212	2.59	7.96
Total	$52,209,006	$160,715,000	$2.84	$8.75

Table 9. Annual Average Increased Gross Returns Due to Reduced Hail and Enhanced Rainfall

County	Direct Impact	Total Bus. Activity	Direct Impact per planted acre	Total Bus. Activity per planted acre
Adams	$802,607	$2,470,649	$4.69	$14.44
Barnes	3,403,456	10,476,824	5.23	16.09
Benson	2,388,239	7,351,664	5.37	16.52
Billings	190,976	587,879	3.52	10.85
Bottineau	2,948,614	9,076,666	5.06	15.57
Bowman	548,702	1,689,061	3.93	12.10
Burke	1,357,354	4,178,311	5.20	16.02
Burleigh	1,079,417	3,322,754	4.48	13.78
Cass	4,588,530	14,124,816	4.99	15.35
Cavalier	2,782,570	8,565,516	4.13	12.73
Dickey	1,809,097	5,568,923	5.41	16.65
Divide	1,198,079	3,688,022	4.33	13.32
Dunn	692,384	2,131,356	3.20	9.85
Eddy	1,063,938	3,275,107	6.09	18.74
Emmons	1,845,504	5,680,976	5.62	17.30
Foster	1,597,859	4,918,666	6.21	19.13
Golden Valley	712,095	2,192,024	5.71	17.59
Grand Forks	1,501,960	4,623,450	2.47	7.59
Grant	1,072,843	3,302,520	4.43	13.63
Griggs	1,363,820	4,198,226	5.29	16.29
Hettinger	1,421,098	4,374,532	4.60	14.16
Kidder	668,693	2,058,429	4.53	13.94
LaMoure	2,532,067	7,794,423	5.75	17.69
Logan	985,057	3,032,285	5.30	16.33
McHenry	1,929,815	5,940,525	5.63	17.35
McIntosh	1,360,457	4,187,875	5.91	18.19
McKenzie	804,609	2,476,813	3.56	10.94
McLean	2,269,862	6,987,288	4.06	12.50
Mercer	574,409	1,768,191	4.05	12.45
Morton	1,114,799	3,431,671	3.67	11.31
Mountrail	1,390,834	4,281,386	3.83	11.78
Nelson	2,234,166	6,877,391	6.03	18.57
Oliver	448,180	1,379,625	3.96	12.19
Pembina	1,357,929	4,180,047	3.05	9.40
Pierce	1,908,502	5,874,911	6.43	19.81
Ramsey	2,916,805	8,978,741	6.07	18.69
Ransom	1,444,300	4,445,972	4.94	15.20
Renville	1,810,911	5,574,494	5.02	15.45
Richland	4,552,632	14,014,308	6.69	20.58
Rolette	1,300,095	4,002,058	5.91	18.19
Sargent	1,441,193	4,436,398	4.67	14.39
Sheridan	1,180,792	3,634,820	5.55	17.09
Sioux	320,263	985,858	4.82	14.85
Slope	473,221	1,456,710	3.49	10.75

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Table 9. Continued

County	Direct Impact	Total Bus. Activity	Direct Impact per planted acre	Total Bus. Activity per planted acre
Stark	$926,693	$2,852,629	$3.29	$10.13
Steele	1,500,257	4,618,207	4.26	13.12
Stutsman	3,512,876	10,813,628	5.30	16.32
Towner	1,731,042	5,328,628	4.21	12.97
Traill	1,563,435	4,812,696	3.61	11.12
Walsh	756,080	2,327,408	1.53	4.70
Ward	2,857,925	8,797,508	4.51	13.87
Wells	2,113,374	6,505,571	4.37	13.46
Williams	2,278,081	7,012,564	5.43	16.70
Total	$86,628,497	$266,667,000	$4.72	$14.52

Table 10. Economic Impact of Reduced Hail and Enhanced Rainfall by Economic Sector

Sector	-- $000 --	-- % --
Households	134,481	50.4
Retail trade	64,512	24.2
Fin., Ins., and real estate	14,562	5.5
Services	13,748	5.2
Trans., Comm., and Pub. Util.	9,945	3.7
Construction	7,814	2.9
Other [1]	21,605	8.1
Total	$266,667	100%

[1] Other category includes: Ag. crops, Ag. livestock, nonmetal mining, Ag. proc., manufacturing, and government.

Table 11. Estimated Increase in State Revenue Due to Reduced Hail and Enhanced Rainfall

State Tax Revenues:	- $000 -
Sales and use tax	$2,987
Personal income tax	1,758
Corporate income tax	356
Total	$5,101

CONCLUSIONS

The results of the analysis presented here indicate that a statewide hail suppression program could offer very substantial benefits to North Dakota. The direct impact of hail reduction was estimated to be $34.4 million annually - - more than 10 times the $3.2 million annual cost of operating the program. When the impact of enhanced rainfall is added to the impact of hail reduction, the result is an estimated increase in the value of crop output of $86.6 million. When these direct impacts are applied to the North Dakota input-output model, the total annual impact of $267 million is estimated. The increases in household income, retail sales, and gross business volume in various sectors of the state economy resulting from the statewide program would result in increases in the state tax revenue of more than $5 million annually. Overall, the statewide hail suppression program offers the prospect of substantial benefits to North Dakota.

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APPENDIX A. TEN-YEAR AVERAGE YIELDS AND PRICES FOR WHEAT, BARLEY, OATS, SUNFLOWER, FLAX, CORN GRAIN, SOYBEANS, AND DRY EDIBLE BEANS BY NORTH DAKOTA COUNTIES, 1988-1997

Appendix Table A1. Annual Average Crop Yields Per Harvested Acre (1988-1997)

Counties	All Wheat	All Barley	Oats	All Sunflower	Flax	Corn grain only	Soybeans	Dry edible beans
	Bu/acre	Bu/acre	Bu/acre	Lbs/acre	Bu/acre	Bu/acre	Bu/acre	Cwt/acre
Adams	23.3	32.0	40.5	718.2	11.5	32.2	NA	3.4
Barnes	32.2	51.7	55.7	1,321.3	17.4	64.8	23.5	9.5
Benson	27.3	44.7	44.2	1,027.8	13.9	53.6	14.1	9.5
Billings	23.5	34.8	44.5	666.3	10.7	45.3	NA	NA
Bottineau	29.6	46.1	59.8	1,108.1	16.4	47.0	12.6	9.0
Bowman	25.4	33.4	43.0	940.8	9.3	32.4	16.0	2.6
Burke	29.1	40.8	50.2	876.1	13.5	34.2	8.3	7.1
Burleigh	22.0	33.7	41.7	836.6	11.8	67.0	14.3	7.8
Cass	37.0	56.1	59.7	1,396.6	16.9	80.5	26.0	11.6
Cavalier	29.5	49.6	56.2	1,096.5	19.0	58.9	16.6	9.6
Dickey	30.2	45.0	54.6	1,373.7	13.4	84.3	22.8	13.9
Divide	27.6	34.5	48.6	826.7	14.2	NA	8.0	7.3
Dunn	24.5	36.1	47.2	746.9	11.0	35.2	NA	2.5
Eddy	26.1	44.0	46.9	1,044.7	14.6	56.9	15.5	9.8
Emmons	21.2	35.5	46.8	814.3	10.5	88.3	17.8	9.1
Foster	29.4	49.0	52.6	1,180.4	15.5	73.4	19.1	10.0
Golden Valley	26.2	36.8	49.6	1,020.1	16.2	62.7	17.0	9.0
Grand Forks	37.6	56.5	53.9	1,222.6	15.8	79.2	23.5	11.0
Grant	21.0	29.2	40.5	827.7	12.1	57.3	12.0	4.4
Griggs	29.8	49.4	54.6	1,298.2	14.6	76.5	18.6	9.9
Hettinger	27.7	36.2	44.4	835.2	12.2	35.8	18.5	3.6
Kidder	22.3	35.7	42.6	1,080.9	14.7	99.1	22.2	9.8
LaMoure	31.4	49.8	55.2	1,331.6	14.8	74.6	25.3	12.0
Logan	24.2	37.8	50.7	1,014.5	12.3	91.6	16.5	NA
McHenry	26.1	42.7	49.1	1,106.8	13.9	61.8	NA	8.1
McIntosh	21.1	34.0	46.1	998.9	11.3	55.5	23.3	10.0
McKenzie	27.6	35.7	49.1	719.5	10.6	84.4	NA	15.2
McLean	27.2	41.1	48.4	945.9	13.7	68.0	13.8	8.3
Mercer	26.3	36.2	49.1	709.8	12.4	71.9	7.0	6.3
Morton	22.6	33.4	44.6	754.9	9.8	72.2	5.0	9.3
Mountrail	28.0	42.4	52.8	887.4	14.3	43.9	10.3	7.3
Nelson	28.8	49.3	50.6	1,175.5	15.7	58.2	21.4	10.3
Oliver	24.3	37.5	46.4	884.0	11.6	63.4	NA	7.6
Pembina	35.2	58.0	58.6	1,343.1	20.9	72.4	22.6	11.0
Pierce	25.5	41.9	45.7	1,083.6	13.9	53.5	9.8	10.1
Ramsey	27.8	47.0	49.8	1,082.8	16.0	54.9	15.7	10.0
Ransom	33.1	49.9	58.8	1,385.8	14.0	92.5	24.7	13.4
Renville	30.5	45.9	54.2	1,100.6	17.6	32.9	9.0	10.0
Richland	37.0	53.4	55.6	1,402.0	17.4	88.2	27.2	13.3
Rolette	27.5	47.0	51.8	1,015.5	15.9	48.2	10.3	7.0
Sargent	32.6	50.1	58.4	1,309.3	14.4	84.0	24.7	12.2
Sheridan	24.1	37.2	43.3	913.5	12.9	40.2	12.8	7.2
Sioux	19.5	28.5	39.1	714.3	9.8	89.4	15.9	NA
Slope	26.7	39.1	43.4	807.0	9.2	24.5	NA	4.3
Stark	24.2	32.1	45.6	767.5	10.9	41.0	NA	3.2
Steele	32.9	53.9	56.8	1,391.4	16.9	83.7	24.5	11.3
Stutsman	29.1	48.8	53.6	1,166.5	17.0	72.0	20.5	10.2
Towner	26.8	44.2	46.4	1,046.6	14.5	50.8	12.8	9.6
Traill	37.1	58.5	58.3	1,383.5	20.4	80.5	26.2	11.0
Walsh	35.1	53.1	54.5	1,166.1	15.6	67.9	21.6	10.5
Ward	29.2	46.3	54.1	1,129.0	15.5	47.2	9.3	8.6
Wells	28.8	46.7	49.6	1,092.9	15.4	53.3	14.9	10.0
Williams	25.2	32.2	43.5	769.4	12.5	67.5	NA	13.5
Average	27.9	42.7	49.8	1,035.1	14.1	62.6	17.1	9.0

Appendix Table A2. Annual Average Crop Marketing Year Price/Unit (1988-1997)

Counties	All Wheat	All Barley	Oats	All Sunflower	Flax	Corn grain only	Soybeans	Dry edible beans
Adams	$3.66	$2.00	$1.33	$0.10	$5.52	$2.33	NA	$19.50
Barnes	$3.58	$2.31	$1.45	$0.12	$5.29	$2.32	$6.05	$19.32
Benson	$3.73	$2.11	$1.33	$0.10	$5.31	$2.32	$6.05	$19.32
Billings	$3.63	$2.00	$1.33	$0.09	$5.15	$2.67	NA	NA
Bottineau	$3.72	$2.11	$1.33	$0.10	$5.31	$2.32	$5.83	$19.32
Bowman	$3.69	$2.00	$1.33	$0.10	$5.45	$2.26	$5.53	$21.93
Burke	$3.81	$2.17	$1.33	$0.09	$5.41	$2.17	$5.96	$19.63
Burleigh	$3.68	$1.97	$1.42	$0.10	$5.49	$2.32	$6.12	$19.32
Cass	$3.58	$2.31	$1.45	$0.12	$5.02	$2.32	$6.05	$19.32
Cavalier	$3.58	$2.09	$1.33	$0.13	$5.33	$2.31	$5.99	$19.32
Dickey	$3.64	$2.04	$1.35	$0.11	$5.55	$2.32	$6.05	$19.32
Divide	$4.02	$2.17	$1.33	$0.09	$5.52	NA	$5.32	$21.53
Dunn	$3.60	$2.03	$1.41	$0.10	$5.26	$2.36	NA	$25.50
Eddy	$3.66	$2.01	$1.31	$0.11	$5.49	$2.32	$5.94	$19.32
Emmons	$3.64	$1.97	$1.42	$0.10	$5.49	$2.32	$5.94	$19.32
Foster	$3.63	$2.01	$1.31	$0.11	$5.49	$2.32	$6.05	$19.08
Golden Valley	$3.75	$2.00	$1.33	$0.10	$4.89	$2.33	$5.53	$16.90
Grand Forks	$3.50	$2.09	$1.33	$0.12	$5.33	$2.32	$6.05	$19.32
Grant	$3.64	$1.97	$1.42	$0.10	$5.49	$2.32	$5.19	$19.08
Griggs	$3.58	$2.31	$1.45	$0.12	$5.29	$2.32	$6.05	$19.32
Hettinger	$3.65	$2.00	$1.33	$0.10	$5.42	$2.33	$6.24	$19.63
Kidder	$3.67	$2.01	$1.31	$0.11	$5.49	$2.32	$6.27	$19.32
LaMoure	$3.64	$2.04	$1.35	$0.11	$5.55	$2.32	$6.05	$19.32
Logan	$3.64	$2.04	$1.35	$0.11	$5.55	$2.33	$6.23	NA
McHenry	$3.58	$2.11	$1.33	$0.10	$5.31	$2.32	NA	$19.08
McIntosh	$3.64	$2.04	$1.35	$0.11	$5.55	$2.32	$6.38	$16.90
McKenzie	$3.74	$2.03	$1.41	$0.10	$5.41	$2.33	NA	$19.08
McLean	$3.89	$2.03	$1.41	$0.10	$5.49	$2.32	$5.89	$19.32
Mercer	$3.66	$2.03	$1.41	$0.11	$5.26	$2.33	$5.32	$18.98
Morton	$3.65	$1.97	$1.42	$0.10	$5.27	$2.32	$6.95	$20.30
Mountrail	$4.06	$2.17	$1.33	$0.09	$5.52	$2.34	$6.01	$21.00
Nelson	$3.55	$2.09	$1.33	$0.12	$5.33	$2.32	$6.05	$19.32
Oliver	$3.60	$2.03	$1.41	$0.10	$5.49	$2.33	NA	$19.32
Pembina	$3.50	$2.09	$1.33	$0.11	$5.33	$2.32	$6.05	$19.32
Pierce	$3.68	$2.11	$1.33	$0.10	$5.31	$2.33	$5.96	$18.71
Ramsey	$3.61	$2.09	$1.33	$0.13	$5.33	$2.33	$5.97	$19.32
Ransom	$3.64	$2.04	$1.35	$0.11	$5.34	$2.32	$6.05	$19.32
Renville	$3.75	$2.17	$1.33	$0.09	$5.52	$2.20	$5.32	$16.90
Richland	$3.64	$2.04	$1.35	$0.11	$5.46	$2.32	$6.05	$19.32
Rolette	$3.81	$2.11	$1.33	$0.10	$5.31	$2.33	$7.00	$19.24
Sargent	$3.64	$2.04	$1.35	$0.11	$5.42	$2.32	$6.05	$19.32
Sheridan	$3.63	$2.01	$1.31	$0.10	$5.49	$2.32	$5.95	$19.65
Sioux	$3.69	$1.97	$1.42	$0.10	$5.11	$2.19	$5.80	NA
Slope	$3.68	$2.00	$1.33	$0.10	$4.45	$2.32	NA	$20.68
Stark	$3.64	$2.00	$1.33	$0.10	$5.18	$2.36	NA	$20.65
Steele	$3.58	$2.31	$1.45	$0.12	$5.17	$2.32	$6.05	$19.32
Stutsman	$3.65	$2.01	$1.31	$0.10	$5.49	$2.32	$6.05	$19.32
Towner	$3.71	$2.09	$1.33	$0.12	$5.33	$2.30	$6.10	$19.32
Traill	$3.58	$2.31	$1.45	$0.14	$4.67	$2.32	$6.05	$19.32
Walsh	$3.50	$2.09	$1.33	$0.12	$5.33	$2.32	$6.05	$19.32
Ward	$3.83	$2.17	$1.33	$0.09	$5.52	$2.32	$5.96	$19.32
Wells	$3.68	$2.01	$1.31	$0.11	$5.49	$2.32	$5.94	$19.32
Williams	$3.81	$2.17	$1.33	$0.09	$5.41	$2.31	NA	$19.08
Average	$3.67	$2.08	$1.36	$0.11	$5.35	$2.32	$5.99	$19.48

NDCC, 61-04.1-03.1

TEXT

NORTH DAKOTA CENTURY CODE
TITLE 61. WATERS
CHAPTER 61-04.1. WEATHER MODIFICATION

Current through End of 1997 Reg. Sess.

61-04.1-03.1 Atmospheric resource board.

The North Dakota legislative council is hereby authorized to delete, where appropriate, "weather modification board" wherever it appears in the North Dakota Century Code or in the supplements thereto and to insert in lieu of each deletion "atmospheric resource board". Such changes are to be made when any volume or supplement of the North Dakota Century Code is being reprinted. It is the intent of the legislative assembly that the atmospheric resource board shall be substituted for, shall take any action previously to be taken by, and shall perform any duties previously to be performed by the weather modification

TEXT

board.

CREDIT

Source: S.L. 1987, ch. 53, § 4.

NDCC 61-04.1-03.1
ND ST 61-04.1-03.1
END OF DOCUMENT