

# CLOUD SEEDING

## PROVIDES SIGNIFICANT ECONOMIC IMPACTS

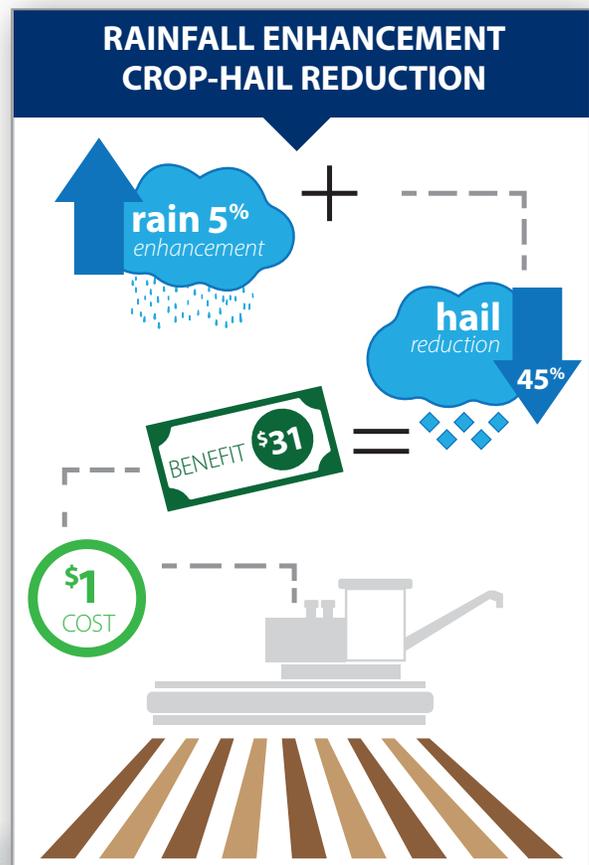
A recent study from the NDSU Department of Agribusiness and Applied Economics (Bangsund and Hodur, 2019) describes the significant economic benefits cloud seeding provides to agricultural production in the western North Dakota counties of Bowman, McKenzie, Mountrail, part of Slope, Ward and Williams. Average annual benefits for the nine crops included in the study range from \$12.20 to \$21.16 per planted acre for the years 2008-2017. Considering cloud seeding operations cost about \$0.40 per planted acre, the benefits far outweigh the costs.

The economics of the North Dakota Cloud Modification Project (NDCMP) were evaluated based on long-term studies of the impacts of seeding on rainfall and hail. Rainfall enhancement effects were evaluated at 5 and 10 percent, which are the lower and upper bounds of typical results, while hail suppression was evaluated at a 45 percent reduction in crop loss. Impacts were computed for the eight most commonly planted crops in North Dakota plus alfalfa, which covers 96.5 percent of harvested acreage statewide on average for the study period.

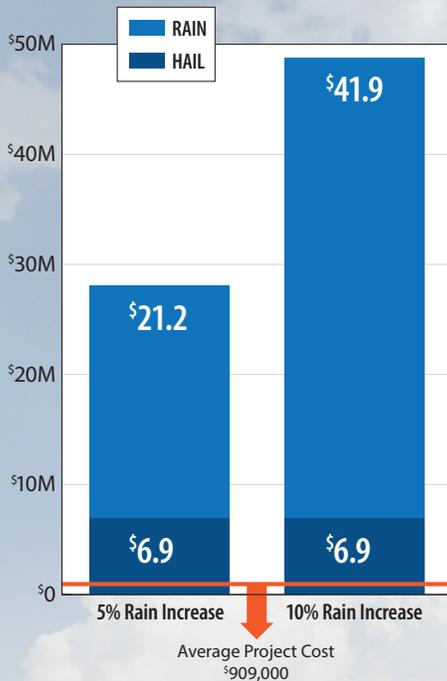
## RESEARCH FINDINGS

Results of the study show the NDCMP is strongly economic, even with its most conservative estimates. The value of added growing season rainfall at 5 percent enhancement is estimated at \$21.2 million annually, or \$9.19 per planted acre. When evaluating rain enhancement at 10 percent, the number jumps to \$41.9 million, or \$18.15 per planted acre. The addition of hail suppression adds another \$6.9 million annually, or \$3.00 per planted acre.

Rainfall enhancement at 10 percent and crop-hail reduction of 45 percent yields estimated economic returns of more than \$53 dollars for every \$1 spent on the program. Viewed more conservatively, using rainfall enhancement of 5 percent, results are still impressive, yielding nearly \$31 dollars of benefit for every dollar spent. “Considering a program cost of only \$0.40 per acre, the NDCMP would only need to improve yields from reduced hail damage, increased growing season rainfall, or a combination of the two, by about one-tenth to one-quarter of a bushel per acre for most crops,” said study author Dean Bangsund. “The NDCMP appears to require an extremely low threshold of efficacy to match program costs to added producer benefits.”



## ECONOMIC BENEFITS



Enhanced agricultural production from cloud seeding is also reflected elsewhere in the economy. Tax revenue from increased crop yields is estimated to range between \$576,000 to \$999,000 annually, which is more than the State provides yearly in cost-share funding with participating counties.

One thing to keep in mind when considering these results is that the study only looked at benefits to agriculture. There is no estimate in this study of what the potential reduction in hail damage to buildings and vehicles may be, but when hail is suppressed, cities and farmsteads also reap the benefits. For instance, a hail suppression program has operated in Alberta, Canada for the last 25 years specifically to reduce property damage from hail in the cities of Calgary and Red Deer.

“North Dakota remains one of the hardest hit regions for hail damage to agricultural crops in the United States,” said Bangsund. “Given the tight margins and financial risk producers face each year, having a program that works to mitigate hail damage and enhance revenue to producers is a real benefit to the state.”

## CLOUD SEEDING PROVIDES SIGNIFICANT ECONOMIC IMPACTS

### COST

= **\$0.40**  
per planted acre

### HAIL SUPPRESSION

**ADDS** = **\$3.00**  
per planted acre

### GROWING SEASON RAINFALL

**10%**  
enhancement = **\$18.15**  
per planted acre

### GROWING SEASON RAINFALL

**5%**  
enhancement = **\$9.19**  
per planted acre

