Section 1: Nutrient Management Survey Methods, Response Rate, and Data Analysis

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Over the last decade many advancements have been made in crop nutrient management and precision ag management. Currently, farmers have many precision ag technologies at their fingertips to help them make farm management decisions. These technologies range from the use of GPS to guide planting and spraying to using spatial information such as multiple layers (years) of yield information, field topography, and soil types to guide planting and fertilizing decisions. In fact, all these options may feel like an information overload to many farmers. The overall goals of South Dakota State University Extension are to understand the current management practices farmers are using, identify information gaps, and then provide science-based information and training to fill the gaps. This information and training help farmers understand the "why" and "how to" of different management practices that can help them improve their economic profit while minimizing potential negative environmental effects. To best accomplish this work, Extension personnel need to know what nutrient management practices and precision agriculture technologies are used by farmers. Therefore, we developed a nutrient management survey, and disseminated it to approximately 3,000 farmers throughout South Dakota (SD) in June to July of 2019. The survey consisted of questions regarding past, current, and future nutrient management practices along with reasons for usage/non-usage. Questions were also asked concerning the source, rate, timing, and placement, of fertilizers and their applications. This survey information enables us to characterize local, regional, and statewide nutrient management practices. These nutrient management practices used in the different regions of SD will also be used as a baseline to compare against innovative management practices that will be developed over the next 5 to 10 years. This survey had two main objectives: 1) identify information farmers use to make fertilizer source, rate, timing, and placement decisions, and 2) determine the adoption rate of various fertilizer management practices that include the 4 Rs of nutrient management (Right: source, rate, timing, and placement).

Response Rate

The survey was sent to 3,000 SD farmers in the summer months of 2019. Farmer contact information was purchased from Farm Market ID, a company that provides contact information for agricultural farmers in the U.S. along with their record of planted acres in 2017. Using private vendors for samples is considered the best practice for obtaining representative data on agricultural farmers in the U.S. (Ulrich-Schad et al. 2022). Farmers who made more than $150,000 in gross farm income were selected randomly using stratified proportionate sampling from six SD ag districts in the central and eastern part of the state where most of the commodity crops in SD are produced (Figure 1).

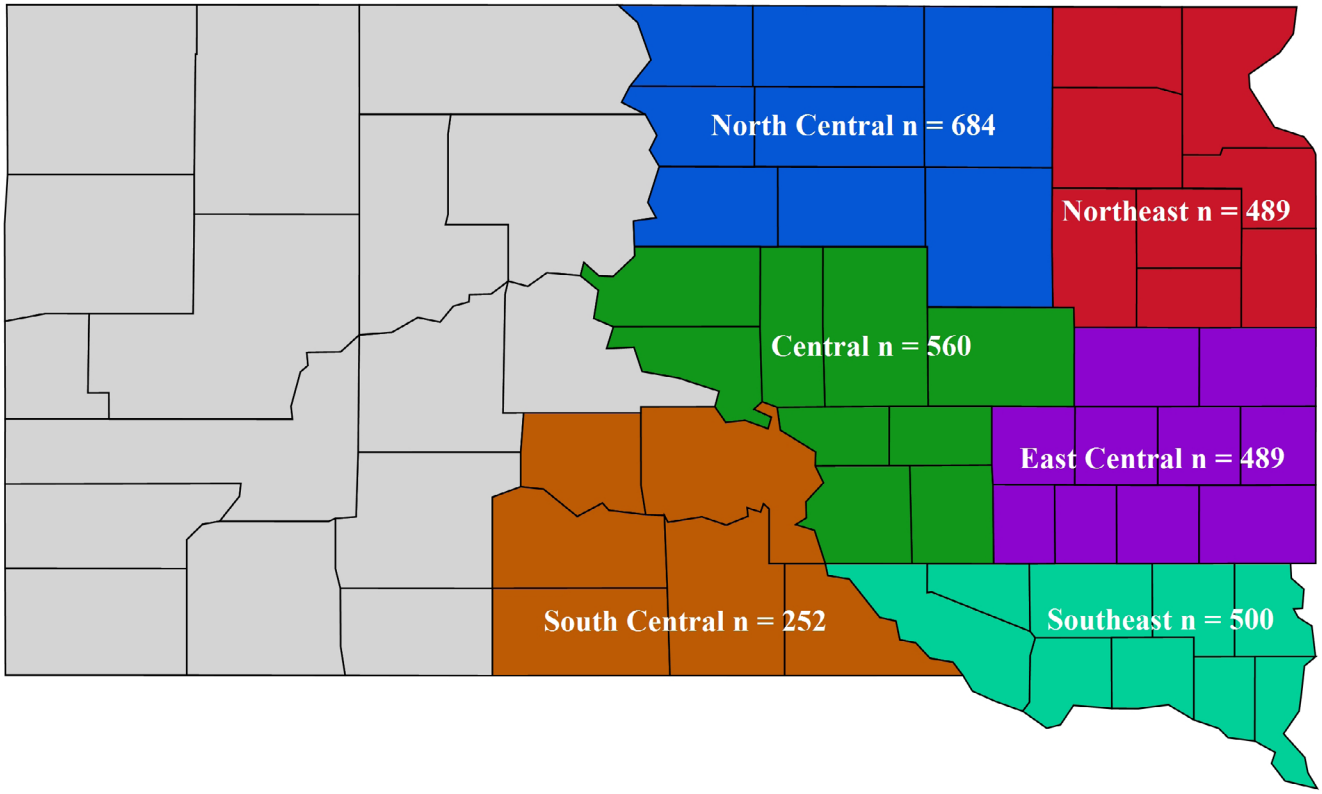

Figure 1. Number of surveys sent to farmers in six South Dakota Agriculture Districts.

Farmers were contacted three times (Figure 2). First, an advance letter including a 2-dollar incentive informing them about the purpose of the survey and how the information gathered will benefit them by providing research and educational programs that will meet their needs, optimize production, and protect the environment. The advance letter also contained a link to the online survey so that farmers who wanted to take the survey immediately online could do so. The second contact was a mail survey which included a stamped return envelope for those who did not respond to the advance letter. The last contact was another mail survey with a stamped return envelope for those who did not respond to the first and second contact attempts. To respondents in the sample who had email addresses, up to three emails were sent with a link to the survey (n=1362; 45% of selected farmers) reminding them to complete the survey if they had not done so.

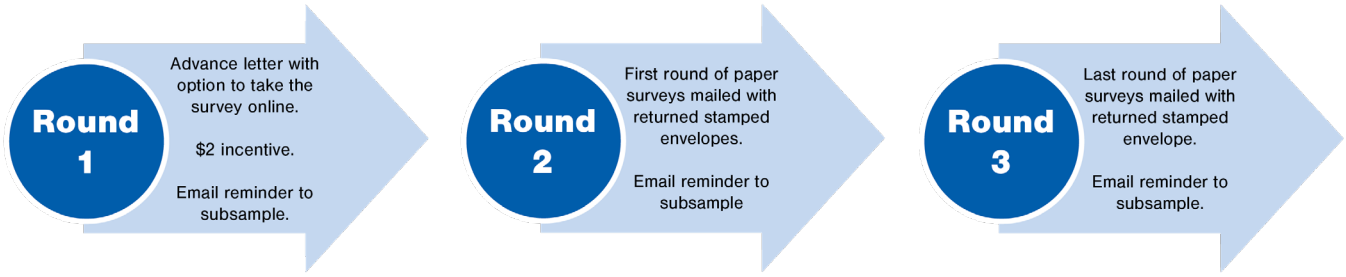

Figure 2. Explanation of each contact round with farmers chosen to participate in survey.

The overall response rate for the survey was 18% with 465 farmers completing the survey (online =176 and mail =289) (Table 1). Bad mailing addresses, farmers who refused to participate in the survey, and those that were not currently farming or retired were 56, 16, and 326, respectively. These three groups were not included in the final calculation of the response rate.

Table 1. Survey response rate in South Dakota and by each Ag District.

Crop District	Sample Size	Response Rate
Central	560	20%
East Central	515	16%
North Central	684	16%
Northeast	489	15%
South Central	252	17%
Southeast	500	18%
Total:	3,000	18%

Data analysis

Geographic location within SD, tillage type, and farm size were the three variables we investigated to determine their relationship with the use of various nutrient management practices. For use of starter fertilizer, we also evaluated farmer age and education level. For geographic location, the surveyed area (eastern portion of SD) was divided into two regions—eastern and central. This division is based on precipitation differences, with the eastern region (22–28 in.) receiving more annual rainfall than the central region (16–22 in.) (Fisichelli et al., 2016). Many farmers in SD are transitioning from conventional to conservation tillage practices. This transition has the potential to alter nutrient management practices. Therefore, we evaluated the relationship between tillage type used (no-till, reduced-till, and conventional tillage) and the chosen nutrient management practices. Lastly, farm size has been shown to be related to the adoption of conservation practices likely due to larger farms greater ability to spread out financial risks (Ulrich-Schad et al., 2017). Thus, we divided farms into four categories (1-499, 500-999, 1,000-1,999, and >1,999 ac) to determine their relationship with the chosen nutrient management practices. The number of farms within each combination of the location, tillage, and farm size groups is contained in Table 2. We also evaluated the relationship between farmer age (18-49, 50-50, and 60+) and formal education attained (college degree or not) on the use of starter fertilizer and its associated management practices (i.e., placement and rate). Descriptive analysis including percentages was conducted to provide information about various nutrient management practice usage among farmers. Chi-square analysis was used to examine the relationship between location, tillage, farm size, and farmer age and education on nutrient management practices.

Table 2. Percentage of farms within each location, tillage practice, and farms size category combination.

Variable category	Location		Tillage practice		
	Central	East	No-till	Reduced	Conventional
	%				
Tillage practice					
No-till	79	29	NA	NA	NA
Reduced	9	18	NA	NA	NA
Conventional	12	53	NA	NA	NA
Farm size (ac)					
>1,999	42	16	39	18	11
1,000-1,999	36	31	35	35	33
500-999	15	35	18	36	34
1-499	7	18	8	11	22

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