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DEFINING PROGRAMMING DIRECTIONS AND PRIORITIES WITH RESPECT TO WATER QUALITY AND ROW CROP PRODUCTION

Carlson, B. M., Associate Extension Professor, University Of Minnesota Extension

ABSTRACT

A needs assessment was conducted using Turning Point to guide Extension efforts regarding agricultural drainage and water quality in Minnesota. The survey gave interesting results with respect to the status of drainage on farms. It indicated a lack of knowledge with respect to both the process and the science through which water quality issues are addressed. An encouraging result was a large percentage of respondents that acknowledge the connection between agriculture and water quality issues. The study is leading to the development of Extension programs to address the findings.

JUSTIFICATION

The Minnesota Corn Growers have partnered with University of Minnesota Extension to invest significant assets into outreach efforts dealing with agricultural drainage and water quality issues that relate to agriculture (nitrate, phosphorus, bacteria, pesticides). These efforts were in a state of transition in the winter of 2012 due to staff changes. It was therefore decided that a needs assessment should be conducted to direct efforts.

MATERIALS AND METHODS

A standard survey was developed which asked 22 questions. These questions regarded the status of agricultural drainage on individual farms, farmer's knowledge and perception of clean water issues, risk tolerance, and the status of precision agriculture technology adoption (because this was seen as a potential way to address problems). In addition, demographic questions were asked so that responses could be sorted as to whether the responder was a farmer, worked for an input dealer, was an independent crop consultant, or had some other role.

Turning Point 2008 (Turning Technologies, Youngstown, OH) was used to collect the data. This technology has the ability to track individual responses across all questions while keeping the respondent anonymous. The survey was delivered at 24 events to a combined audience of over 1000 individuals. An effort was made to deliver the survey state-wide, but the majority of the participants were from the southern third of the state. Attendees were instructed to not respond to the survey if they had previously participated. A total of 696 responded to at least one question. It should be noted that participants did not necessarily respond to any given question, meaning the total number of answers varies for each question. As Turning Point was designed primarily for testing and for accommodating audience participation, its use in data collection was not straight forward. Techniques were developed to be able to organize and analyze the data (Carlson, 2014). Data was exported into an Excel (Microsoft, Redmond, WA) spreadsheet, sorted, and summarized using basic statistics.

Responses from the four demographic categories were analyzed separately. Farmer responses to all questions were of importance, while only certain questions were of importance from the Ag Professionals. The number of responses by independent crop consultants was deemed too small to reliably use the data. Responses from the "other" category were analyzed, but as there was no good way of classifying the responders it was decided that the data was not useable.

Farmers were asked the number of acres they farmed in one of eight categories (Figure 1). The total number of acres represented by the survey was estimated by taking the mid-point of each category and multiplying by the number of responses for the category. As only one farmer identified that he was farming over 30,000 acres the figure of 30,000 was used for this individual.

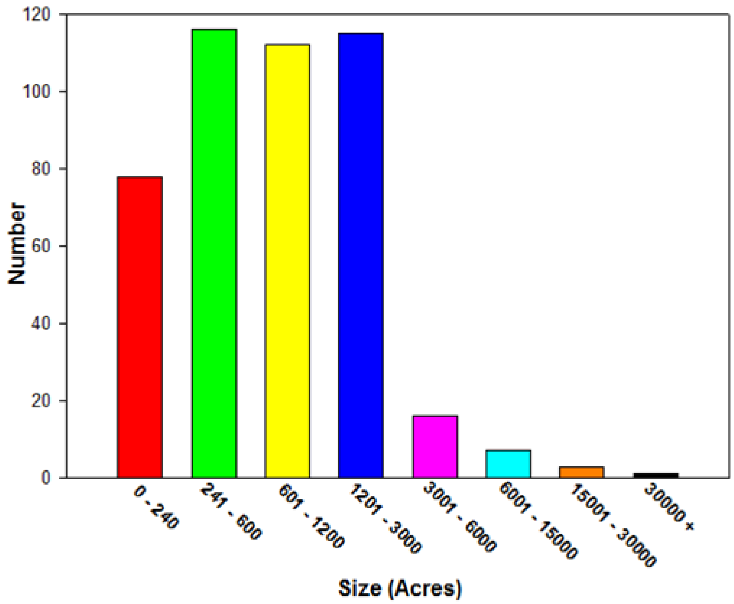

Figure 1. Number of Farmer Respondents by size category.

A similar estimate was made for total drained acres, and farmer's intent on performing additional drainage in the next five years. Farmers were asked what percentage of the land they farmed was artificially drained, as well as what percentage of undrained land still "needed" it. Based on their response and using the mid-point of the size category they identified, an estimate total drained acres was calculated. Furthermore, producers were asked whether they planned to drain "all," "some," or "none" of their acres still needing drainage in the next five years (Figure 2). Turning Point is not able to record open ended responses meaning the exact amount of drainage intended by those answering "some" is not able to be determined. This is a limitation of the survey method, but still gives an indication of the percentage of farmers that will be installing artificial drainage in the near future. For the purpose of data analysis an assumption was made that draining "some" means 50%. From this an estimate of future drainage activity was made.

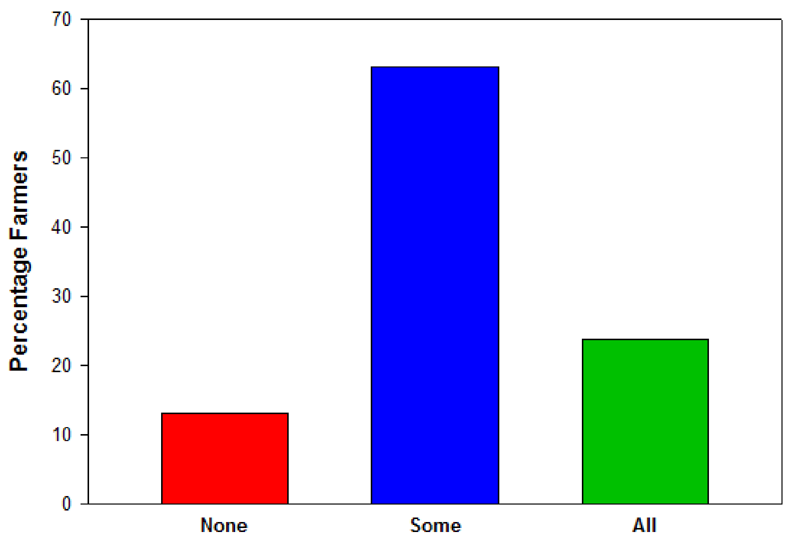

Figure 2. Farmer's intentions to perform perceived necessary agricultural drainage over the next five years as a percentage of farmer respondents.

It was hypothesized that answers might correlate to farm size or to farmer's "attitude" regarding environmental issues. An attempt to define attitude was made based on how they answered a question regarding whether they believed agriculture's responsibility toward water quality issues was "overstated." Responses to other questions were examined based on response to these two questions. The first level of analysis of this data was to determine whether an increasing or decreasing trend exists based on farm size. Following this, a chi squared test was performed using Sigma Plot (Systat Software, San Jose, CA) to determine randomness of the answer distribution, and SAS (SAS Institute, Cary, NC) to compare individual size categories to each other. Chi squared is the only option for statistical analysis, as the responses are categorial, not numeric, making regression or determining least squared differences impossible.

RESULTS AND DISCUSSION

A total of 696 lines of data representing unique responders were collected. Of these, there were 473 farmers, 38 dealers, 11 crop consultants and 168 other. The exact attendance of the events where the survey was administered is not known, and the reasoning for non-participation is not known, but with a total attendance of around 1000, there is an approximate response rate of slightly less than 70%. This compares favorably to a recent study which examined response rate to mailed and/or web based Extension surveys (Israel, 2010). Additionally, of the 473 farmers, the rate of response on any individual question ranged from a low of 82% to as high as 99%, with the majority of questions in the 90% range. The reasons individuals would answer certain questions and choose to not answer others can only be speculated on.

The total acreage represented by the survey was estimated at 643,380. According to Minnesota Agricultural Statistics (Minnesota Department of Agriculture, 2014) there were 26,800,000 acres in farms in 2012 meaning that the survey represented approximately 2.23% of the farmed land in Minnesota. Using these figures the average farm size reported in the survey was 1,343 A.

Analysis of the drainage data gives an estimate of 53% of crop land already drained. Farmers were asked what percentage of their land that was not artificially drained still “needed” it. This equates to 19% of the total, or 40% of the undrained 47%. Farmers were then asked whether they had plans to drain all, some, or none of their land that would still benefit from drainage in the next five years (Figure 2). Based on the responses, an estimated 5.5% of the total land base will have artificial drainage installed in the next five years. When asked who would do their installation 53% said they would hire a professional contractor, 22% said they would do it themselves, and 7% said it would be done by a friend or neighbor (with the balance stating they had no plans). The overall drainage numbers indicate that agricultural drainage is a mature program topic as the amount of crop land to still receive artificial drainage will be decreasing in the years to come. The implications of this are that less focus will need to be on the basics of drainage design and installation and more on specific problems related to drainage.

The term “conservation drainage” applies to a suite of technologies intended to mitigate effects of water conveyed by drainage systems (both quality and quantity). Only 20% of farmers responded that they felt they knew “a lot” about these practices. Minnesota, like all states in the Mississippi River Watershed, is in the process of enacting a nutrient reduction strategy to address the hypoxic zone in the Gulf of Mexico (Minnesota Pollution Control Agency, 2014). This strategy will employ a number of Conservation Drainage practices. As 80% felt that they did not know a lot about these technologies education on these practices should be a priority.

Many farmers report that the desire to conduct additional drainage is being held up due to issues related to potential outlets. These range from being physically unable to perform drainage due to site limitations such as distance, relief, etc., legal issues related to the public drainage system, or to personal issues involving neighbors. The survey shows 59% of respondents reported these issues with a breakdown of the specific problems in figure 3.

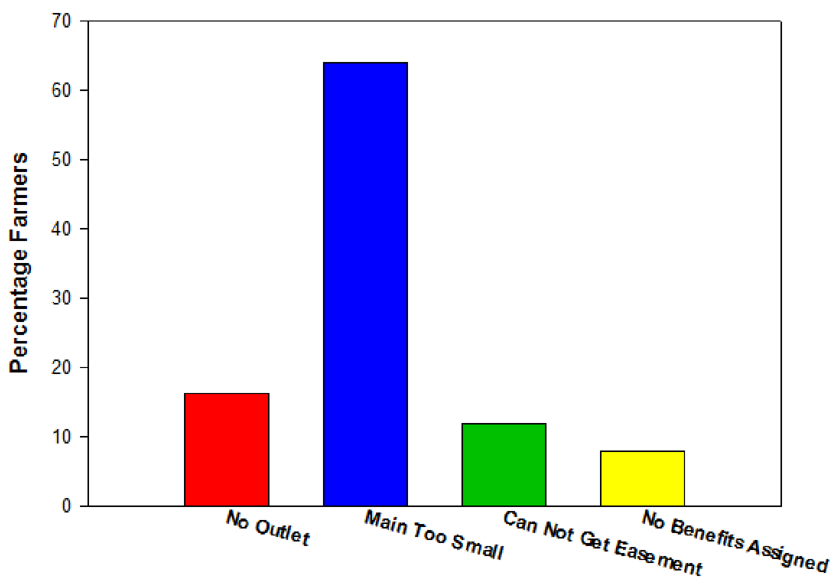

Figure 3. Percentage of farmer respondents reporting various problems associated with outletting water from artificial drainage systems. Responses include: Nowhere to outlet the water, existing tile main is too small to accept the water, drainage needs to cross someone else’s property and they cannot get an easement, and finally they need to outlet into a public drainage system for which no benefits, and therefore no rights to outlet, exist.

Respondents were asked if they believed that University of Minnesota recommended nitrogen rates are adequate. Respondents were given the option of completely agreeing with the recommendations, completely disagreeing with the recommendations, or saying that they disagreed with portions of the recommendations. Only 26% of farmers believed that they are sufficient, with only 82% of responders choosing to answer the question. This is the lowest response rate to any question in the survey. This is a concern because it is theorized that many chose to not answer the question rather than have the results “look bad,” thereby skewing the results. A clear trend exists in the data with the larger farmer categories inclined to say that University recommendations are too low across the board (Figure 4). Only 9% of those working for a dealer believed them to be completely adequate with 92% answering. The Chi Squared analysis shows that there is a significant difference at a p=.2 level between the smallest size category and the category beginning at 1200 acres. Significance involving the largest category cannot be demonstrated to this level, but it should be noted that the number of respondents for this category is much smaller than the other three.

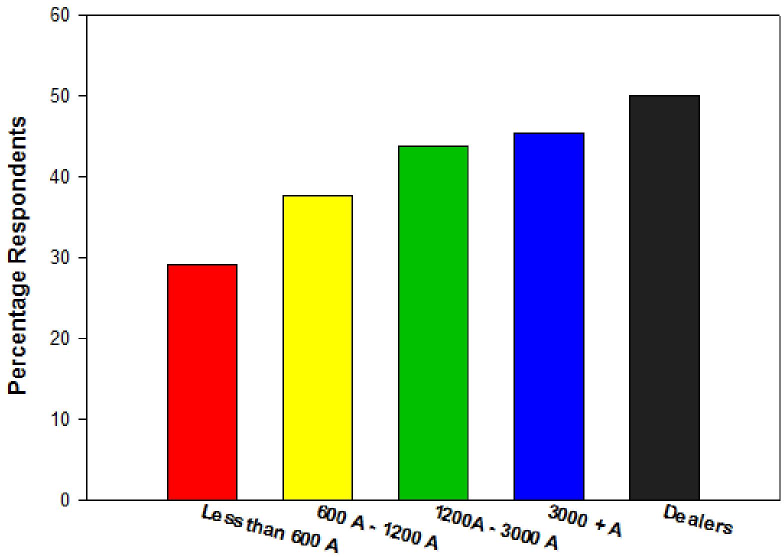

Figure 4. Percentage of respondents that say University of Minnesota nitrogen rate recommendations are too low across the board based on farm size with fertilizer dealers added for comparison.

Changes in nitrogen fertilizer management on the part of many farmers may be necessary to address nutrient reduction goals. The high percentage of farmers, and especially input suppliers, who believe the recommendations are too low is alarming. It should be noted that no effort was made to determine whether respondents actually knew what University of Minnesota recommendations are before answering this question. The data is in contrast to a previous survey (Bierman, 2011) which identified farmer reported application rates that generally fall within University guidelines. Unfortunately, the Bierman study asked farmers what their actual rates were without identifying the circumstances, and therefore is unable to determine whether the rates are in line with recommendations on a site by site basis. This makes a direct comparison between the two data sets difficult. It also should be noted that the Bierman study reports total corn acres only, with an average size of 323 A. A direct comparison based on size cannot be made to this study due to differences in how acreage was reported. The average farm size of this survey was 1,343 A, therefore it should be noted that this survey represented much larger farmers than the Beirman survey. This issue needs to be explored in more detail, as it is imperative that producers are following recommendations prior to implementing other more expensive measures. The implications of the data is not simply that farmers need more education, but responsibility also falls upon the U of M to determine if there are specific situations for which farmers find current recommendations problematic. This is highlighted by a large number of respondents choosing the answer of disagreeing with portions of the recommendations.

When asked if they understood how the Federal Clean Water Act affected them 75% of farmers said they did not, with 83% of dealers reporting the same. A total of 52% of farmers said they did not know whether they farmed in a watershed that was considered impaired, while 77% said they had no idea whether a Total Maximum Daily Load (TMDL) plan was in place where they farmed. While the chi squared analysis indicates that responses to these questions are not random, no trends based on size are apparent. The survey clearly shows that those involved in agriculture do not fully understand the Federal Clean Water Act and the regulatory process through which water quality issues are addressed. This is easily interpreted as being a problem, as many of those who will be asked to respond to water quality problems may resist change due to not understanding the process that is being used. Further discussion needs to occur as to who is responsible for providing education on these topics.

Statements regarding the connection between agriculture and water quality issues were presented to participants. By selecting the statement closest to their personal beliefs, respondents could acknowledge agriculture's role in water quality issues, or that they believed agriculture's responsibility was "overstated." Almost exactly 2/3 chose a statement that acknowledged this connection and accepted responsibility to address the issues. This compares to 83% of the dealers that acknowledge this connection. There does appear to be a trend (p value .20) for the larger farms to more closely identify with the "overstated" response. These responses provide encouraging results, as the majority of farmers seem ready to seek solutions involving themselves and their practices. It needs to be noted that while 33% of farmers chose to identify with the "overstated" answer, this does not mean that they deny any connection between water quality and agriculture. It was hypothesized that farmers that chose to identify with the "overstated" statement might trend toward other "negative" answers (such as believing that N recommendations are too low), but analysis showed little to no connection regarding responses to other questions.

Through a series of survey questions farmer's thoughts on maximizing yields and production vs. maximizing economic return to inputs were examined. An example would be nitrogen fertilizer, where yield response diminishes as the application rate approaches maximum achievable yield. In this case the last units of N fertilizer will produce a negative economic consequence, as yield increase is not sufficient to pay for the added input. Other inputs follow a similar response curve meaning that the highest achievable yield is rarely the most profitable. Farmers were asked if they understood this principle by simply asking whether they thought "Maximum yield is most profitable for my farm." The response of 27%, indicates a need for basic education regarding the economics of crop budgets and inputs. This relationship is important for environmental reasons, as additional inputs beyond economic optimum are frequently under-utilized by the crop and therefore free to move in the environment and cause negative consequence. A second question attempted to define how often a farmer was comfortable "leaving yield on the table" due to this phenomenon. A slightly higher percentage (32%) said never (meaning they want to use enough inputs so as to always achieve the maximum possible yield), while others chose anywhere between one in five years to one in twenty (Figure 5). This is another area where the chi squared test indicates that responses based on size are not random, yet a trend does not exist. The categorical data with respect to how often they would "leave yield on the table" due to uncontrollable circumstances gives a glimpse of the status quo. This is another area where agricultural economists, in addition to soil scientists and water quality experts have a major role to play. Vetsch and Randall in Carlson et. al., 2013, showed the potential for unnecessary N to be lost in the environment. Beyond nutrients, the environmental consequence of many unnecessary inputs is not well documented. These other relationships could be explored in more detail.

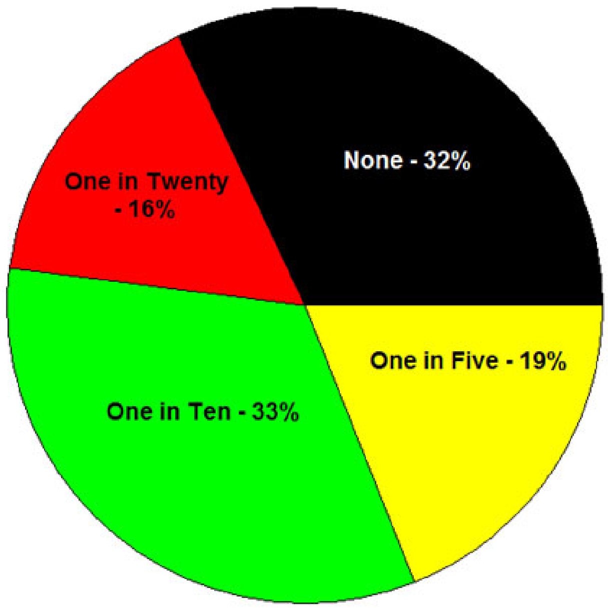

Figure 5. Risk Tolerance of farmers represented by percentage willing to forego maximum obtainable yield via inputs in number of years labled.

Many have suggested that environmental issues might be addressed through the use of precision agriculture technologies. The survey asked farmers the extent to which they are using some of the oldest and most basic precision practices. Farmers responding reported that 40% are not yield mapping, 32% have not used grid soil sampling, and only 21% are variable rate seeding. As might be expected, a definite trend exists with respect to larger farmers adopting more precision agriculture technology (Figure 6). When asked who helps them with their interpretation and decision making 52% said they do it themselves, 25% said an independent crop consultant, 21% said an input supplier, with 1% using their implement dealer.

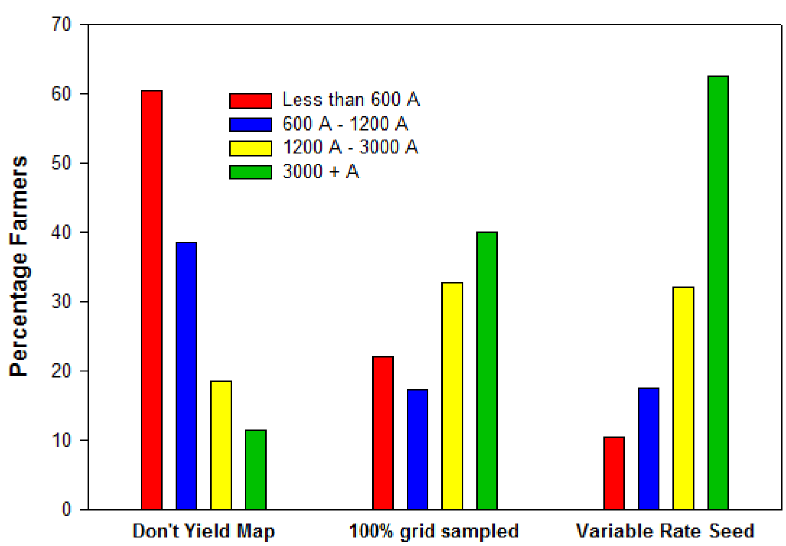

Figure 6. Percentage of farmers reporting whether they yield map, having 100% of their farmed land grid soil sampled, and whether they variable rate seed. Sorted based on farm size in Acres.

CONCLUSIONS AND OUTCOMES

This survey provided a unique data set which has proven to be invaluable for program planning. The method of collection (Turning Point) was fast, economical, and had a high response rate. A major drawback in the survey method is that responses need to be categorical rather than exact, and this makes statistical analysis difficult.

The data regarding the status of drainage installation in Minnesota is being used to guide existing Extension programming on topics of design and installation. Information regarding farmer's knowledge and perception of water quality issues and laws has been both insightful and encouraging, as the data defines definite needs and offers encouragement that farmers are willing to engage in the issues. The survey data regarding N management has been less encouraging, yet it too has led to the development of new Extension programming which focuses on the basics of management and N in the environment. This new farmer focused program should be on-line in 2015. This information has been shared with stakeholder groups, as well as governmental agencies and is helping to guide their work plans.

One final outcome has been the revelation that a very large percentage of farmers are either not using or under using basic precision agriculture technologies. The data provided market research sufficient to justify a new program which targets this group. This concept has been vetted with stakeholders who are supportive of these efforts.

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