



Farming 4R Land



Steps to Follow When Developing a 4R Nutrient Management Plan

Introduction:

The 4R approach is a framework that helps you organize your decisions about nutrients by focusing on what's important; the Right Source @ the Right Rate, Time and Place. It is about using fertilizer more effectively and efficiently and for growers this translates into getting more value for every dollar spent on fertilizer and reducing negative off farm impacts at the same time.

The core of the 4R nutrient management system is applying the Right Source @ Right Rate, Right Time, Right Place®. The key to successful 4R Nutrient Stewardship is including a nutrient management plan that is rooted in all 4R's. This is because the 4R's are based on scientific principles and the best available local evidence. The result is a series of beneficial management practices or BMPs that allow you to convert principles to practical knowledge that fits local conditions.

The 4Rs are not independent. In fact they are highly interrelated and that is why when implementing BMPs you need to consider what the impact of a decision in one R has on the other three. Because the 4Rs are integrated they can work together synergistically, but they can also be antagonistic, in some cases. So always consider 4Rs as a system when developing BMPs and like any system you need to consider how changing one of the components affects the performance of other components. By filling out a 4R Nutrient Management Plan Worksheet, you are able to set goals for incremental improvement.

There are a few things that distinguish 4R Nutrient Stewardship from regular nutrient applications. The first is that the 4Rs are a comprehensive approach to sustainable nutrient management. That is to say, they do not focus on the economic returns, or the environmental impacts, or the social ramifications of nutrient use in isolation. They integrate and look at the overall impact of nutrient management decisions on economic, social and environmental goals.

In fact, 4R does more than just look at a farm's contribution to sustainability, 4R links cropping system performance to sustainability goals in a measurable and traceable way.

The 4R nutrient stewardship is based on the principle of adaptive management and continuous improvement. So developing a 4R Nutrient Management Plan Worksheet is more than just a paper exercise, it's a living document that evolves over time and retains its value going forward.



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Section 1: Farm Information

In this section we are asking for general information which may stay consistent between years. However, this information is very important for understanding the conditions and context of the applied practices. Please also include any information that you think is relevant or unique to your operation. For the categories of total crop area, crops grown, livestock and nutrient sources put the responses that represent the planting season that this plan would take effect, including as much detail as possible.

One of the most valuable resources to help guide your decision making are the services of a professional advisor, whether it be a Certified Crop Adviser, Accredited Professional Adviser or Professional Agrologist. They can assist in the development of a 4R Nutrient Management Plan. These advisors have a good understanding of agronomic science, food safety, agricultural technology, economics and environment, and are able combine that knowledge with local experience and ethical conduct in order to render sound recommendations. With their assistance, you are able to set and meet 4R goals and make decisions that can result in improved performance and environmental stewardship.



If you would like to find out more about the benefits of a Certified Crop Adviser or to find you one in your region, please go to www.prairiecca.ca for the Prairie Provinces of Canada, or <https://www.certifiedcropadviser.org> to find links to other regions in Canada and the USA. To find out about Professional Agrologists or how to contact one, please go to <http://www.aic.ca>, <http://www.albertaagrologists.ca/>.

Required Documentation for the Worksheets:

- 1) Overall information: field size (acres), location, soil type, topography etc.
- 2) Information from previous years on farm crops grown, yield and quality, fertilizer source, rate, time and place
- 3) Map of operation or field
- 4) Most recent soil analysis test results
- 5) Most recent manure analysis test results (if applicable)
- 6) Crop Nutrient Requirements



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Section 2: Sustainability Goals and Indicators Related to Nutrients

The underlying driver behind 4R Nutrient Management is the goal of sustainable nutrient management. While a number of definitions exist for sustainable agriculture, the most common concepts highlight the need to accommodate growing demands for production without compromising the natural resources upon which agriculture depends. Sustainability applies to the multiple dimensions of social, environmental and economic simultaneously. All three must be considered in order to approach sustainability.

The first step in 4R Nutrient Management Planning is to set environmental, social and economic goals for nutrient management on the farm. Goals are not really very useful things unless you can tell when you meet them. Part of goal setting is to start thinking about the performance indicators that will help you measure progress towards the goals.

Good 4R goals need to be relevant to the farming operation, the farmer and his family's needs. They also need to be relevant to other stakeholders in the local and global community and require input from those stakeholders. And finally, goals need to be something that the cropping system can influence.

SUSTAINABILITY GOALS

Environmental

- Sustain or improve soil quality
- Maintain nutrient levels within natural ecosystems
- Preserve wildlife habitat



Economic

- Produce revenue to sustain farm operations
- Preserve quality of life
- Make the most of dollars spent on fertilizer

Social

- Produce nutritious, abundant and affordable food
- Support programs for strong and caring communities
- Help meet global food needs
- Provide ongoing employment opportunities in agriculture and related industries





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So what do sustainable agriculture goals look like? Starting with economic goals, one example is the goal of keeping farms in an economically viable situation. While there needs to be a balance between economic, social and environmental goals, it's hard to imagine a farm that isn't economically viable being able to contribute significantly to social and environmental goals. Of course, one of the main social goals of sustainable agriculture can be the production of nutritionally abundant and affordable food. On the environmental side, there are a large number of ways that agricultural producers can contribute ecological goods and services, including the reduction in greenhouse gas emissions from nutrient application. Depending on the region, surface and groundwater water quality can be a very important factor for the community and municipality. Sustainable cropping systems help ensure clean water and clean air. You must choose the goals and corresponding performance indicators that are the most appropriate to you under each of the sustainability areas.

Performance Indicator Examples	
Yield	Amount of crop harvested per unit of cropland per unit of time
Quality - Harvest	Sugar, protein, minerals, vitamins or other value adding attribute
Quality - Stand	Plant population, tillering, lodging, maturity
Nutrient Use Efficiency	Yield produced or nutrient removed per unit of nutrient applied Residual nutrients levels
Carbon Credits	Nitrous oxide emission estimates, carbon sequestration estimates
Soil Erosion	Degree of soil coverage by actively growing crops and crop residues
Off-field Nutrient Losses	Losses from edge of field, bottom of root zone and top of crop canopy
Factor Cost	Dollars of crop produced per dollar of nutrient input
Soil Productivity	Soil organic matter, and other soil quality indicators
Biodiversity	Difficult to quantify – can be descriptive

Once you have chosen some sustainability goals you will want to spend a bit of time thinking about measuring progress towards those goals, and to do that you need some performance indicators. One thing you'll notice about the goals of sustainable agriculture is that they are measurable. For example, we can measure soil quality in terms of things like soil organic matter, compaction and productivity. We can assess the quality of water that flows off agricultural land by looking at the nutrient and sediment load. In the economic area, farmers measure their profitability and their return on investment. And while the social impact of an individual farm is more difficult to measure, it is certainly possible to measure the impact of the farming community on rural opportunity.



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Section 3: Production Information (for each field or management zone):

The aim of 4R is to improve nutrient management on the farm. In fact it's designed to improve nutrient management on a field-by-field basis. For this reason **Section 3: Production Information** in the 4R Plan Worksheet must be filled out for each field or management zone in your operation.

Once sustainability goals have been set, it is time to gather production information for each field or management zone. In some cases with some farmers, there will be very complete sets of production information based on actual measures. In other cases the information might be a generic value. For example, a producer may not know the nutrient quantities of their manure sample; however, they can get averaged data based on manure source from Provincial Agricultural Ministries or other advisors. These generalized data points can never be as representative as actually measuring a sample, but just by filling out this form you can pinpoint what information you need to gather for the next season and improve your information accuracy over time.

We will now go through the different information that is requested under **Section 3: Production Information**.

- 1) **Legal Location and/or GPS coordinates:** The first piece of information required is the legal location or GPS coordinates. With this information we request you add a map and a description of the field. This can include slopes, proximity to water bodies, presence of manure storage, tile drainage or any other distinguishing features. You can easily make a customized map using Google Maps, your GPS, the Alberta Soil Information Viewer (found at <http://www4.agric.gov.ab.ca/agrasidviewer/>), or a wide range of free products online.
- 2) **Management System (Conventional or Variable Rate):** Here we are just asking you to identify whether you are applying variable rate on your field. If you are applying variable rate then we ask that you fill out all of the following information for each Management Zone.
- 3) **Previous Crop:** Please list crops planted in the last year including any crop rotation
- 4) **Yield and Quality:** Based on location specific history, yield monitors, yield mapping or crop variety, an estimate should be feasible for expected yield and quality.
- 5) **Landscape Topography and Soil Drainage Characteristics:** Topography refers to slopes on the field, the more specific the information the better. Soil drainage can be classified using the Canadian Land Inventory system, be described with infiltration rate or it can be described qualitatively such as a description of which fields have water stands and causes problems after a heavy rain and the ones where it infiltrates rapidly. This information can be found using the

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Alberta Soil Information Viewer found at <http://www4.agric.gov.ab.ca/agrasidviewer/>

- 6) **Soil characteristics based on soil testing:** Please use the information from your latest soil test results. Include the date of the soil test results that you are using. It would be ideal to test soil on a yearly basis in order to monitor and track changes in soil nutrient content over time. However, use whatever information you have available. You may not be able to fill out every box, but this can help identify what information you might be missing and should try to get in the future.
- 7) **Manure Analysis:** As described with the above soil characteristics, it is best to have the most current and appropriate information when applying manure. If you do not have analysis you can use generic values of available nutrients based on livestock type. This can be found from various sources including Provincial Agricultural Ministries (AARD [http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/irr5716](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/irr5716))
- 8) **Current Practice and Beneficial Management Practices (BMP) to Improve Performance:** In the next box you have the opportunity to identify one practice that you do under each of the 4R's and describe how you can improve that practice with a BMP for this planned cropping season. This can then be directly linked to one of the chosen performance indicators. The goal is for incremental change over time and to track what changes you did in previous years. By indicating in this worksheet a planned improvement you can keep records of changes in crop performance. For example, under rate you may typically test your soil every 5 years. You may choose to now test every year. This can help you better match nutrient requirements from your crops with existing nutrient content in your soil and the rate which you apply fertilizer or manure. Another example is that you may typically apply all fertilizer in the fall, but instead you choose to use a split application, for example for a spring planted annual crop (e.g. corn, spring wheat, canola) you might apply some starter fertilizer in furrow or side-banded, and side-band or mid-row band the majority of nitrogen, and the balance of nitrogen as a sidedress or top-dress in-crop application. This can result in less nutrient losses to surface water or less greenhouse gas emissions.

Alberta is unique to have *Specified Gas Emitters Regulations* that includes a Nitrous Oxide Emissions Reductions Protocol (NERP) which allows farmers to apply for offset credits through Alberta Environment and Sustainable Resource Development. We have included a column demonstrating the BMP's required to meet the basic level of the NERP for on farm nitrogen applications. The full table outlining the BMP's for all three performance levels; basic, intermediate and advanced can be found below. Recommendations for phosphorus have also been included that set a benchmark of practices that should occur on farm.

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Overview of the 4R Consistent Plan and BMP Performance Levels for the Drier Soils in Canada

Performance Level	Right Source	Right Rate	Right Time	Right Place	Reduction Modifier
Basic	<ul style="list-style-type: none"> Ammonium-based formulation; 	<ul style="list-style-type: none"> Apply N according to recommendation of 4R N stewardship plan*, using annual soil testing and/or N balance to determine application rate. 	<ul style="list-style-type: none"> Apply in spring; or Split apply; or Apply after soil cools in fall 	<ul style="list-style-type: none"> Apply in bands /Injection 	0.85
Intermediate	<ul style="list-style-type: none"> Ammonium-based formulation; and/or Use slow / controlled release fertilizers; or Inhibitors; or Stabilized N 	<ul style="list-style-type: none"> Apply N according to qualitative estimates of field variability (landscape position, soil variability) 	<ul style="list-style-type: none"> Apply fertilizer in spring; or Split apply; or Apply after soil cools in fall if using slow / controlled release fertilizer or inhibitors / stabilized N 	<ul style="list-style-type: none"> Apply in bands / Injection 	0.75
Advanced	<ul style="list-style-type: none"> Ammonium-based formulation; and/or Use slow / controlled release fertilizers; or Inhibitors; or Stabilized N 	<ul style="list-style-type: none"> Apply N according to quantified field variability (e.g. digitized soil maps, grid sampling, satellite imagery, real time crop sensors.) and complemented by in season crop monitoring 	<ul style="list-style-type: none"> Apply fertilizer in spring; or Split apply; or Apply after soil cools in fall if using slow / controlled release fertilizer or inhibitors / stabilized N 	<ul style="list-style-type: none"> Apply in bands / Injection 	0.75



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- 9) **Crop Nutrient Requirements:** Here we ask you to list the crop to be grown and what nutrient quantities are typically required for that crop. This information can come from a crop consultant, seed company, Provincial Agriculture Ministries or elsewhere. Please indicate your source of information. Using the crop requirements and based on the nutrient content of the soil you can better estimate what amount of additional nutrients need to be applied and whether your rate is sufficient, appropriate or excessive.
- 10) **Planned Nutrient Application:** In this final box you are able to consider all of the information you have provided above to describe your planned nutrient application. All of the 4R's should be considered and accounted for. Does the rate you apply match the crop requirements along with current nutrients found in the soil, or reasonably mineralized from the soil? Is the source able to account for all nutrient requirements for the crop while again accounting for soil contributions? Is the time and place optimal for the crop chosen? This is where you can evaluate and improve your decisions.

Conversion Factors:

Tonne (metric)/hectare x 0.446 = ton/acre	$P \times 2.3 = P_2O_5$
Ton/acre x 2.24 = tonne/hectare	$P_2O_5 \times 0.43 = P$
Tonne x 1.102 = ton	$K \times 1.2 = K_2O$
Ton x 0.9072 = tonne	$K_2O \times 0.83 = K$
Kilogram (kg) x 2.205 = pound	
Pound x 0.454 = kilogram (kg)	
Hectare x 2.47 = acre	
Kilogram/hectare x 0.891 = pound/acre	
Pound/acre x 1.12 = kilogram/hectare	
Acre x 0.405 = hectare	