REGIONAL DISTRICT OF BULKLEY-NECHAKO

AGRICULTURE COMMITTEE AGENDA

THURSDAY, JUNE 23, 2016

PAGE NO.		ACTION
	AGENDA – JUNE 23, 2016	Approve
	Supplementary Agenda	Receive
	MINUTES	
2-8	Agriculture Committee Meeting Minutes - May 26, 2016	Receive
	DELEGATION	
	MINISTRY OF AGRICULTURE John Stevenson, Regional Agrologist RE: Update	
	DISCUSSION ITEMS	
	1. Agriculture Forum 2. Connecting Consumers and Producers	
	CORRESPONDENCE	
9-50	BC Forage Council on Farm Demonstration Research 2nd Draft	Receive
	SUPPLEMENTARY AGENDA	
	NEW BUSINESS	
	ADJOURNMENT	

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AGRICULTURE COMMITTEE MEETING
(Committee of the Whole)

Thursday, May 26, 2016

PRESENT:	Chair	Mark Parker
	Directors	Taylor Bachrach Eileen Benedict Shane Brienen Tom Greenaway Mark Fisher Thomas Liversidge Rob MacDougall Bill Miller Rob Newell Jerry Petersen Darcy Repen Luke Strimbold Gerry Thiessen
	Director Absent	Dwayne Lindstrom, Village of Fraser Lake
	Staff	Cheryl Anderson, Manager of Administrative Services Hans Berndorff, Financial Administrator Deborah Jones-Middleton, Protective Services Manager – arrived at 10:53 a.m. Jason Llewellyn, Director of Planning Jennifer MacIntyre, Planner 1 Maria Sandberg, Planner Corrine Swenson, Manager of Regional Economic Development Wendy Wainwright, Executive Assistant
	Others	Marc Bekar, Smithers – arrived at 10:46 a.m. Claudette Gouger, New Gold Blackwater Project – arrived at 10:42 a.m. Kim Grout, Chief Executive Officer, Agriculture Land Commission Frank Leonard, Chair, Agriculture Land Commission Wade Lubbers, Smithers – arrived at 10:46 a.m. Dave Merz, Vice-Chair, North Panel, Agriculture Land Commission Mark Rossman, Smithers – arrived at 10:46 a.m.
	Media	Flavio Nienow, LD News – arrived at 10:41 a.m.

CALL TO ORDER Chair Parker called the meeting to order at 10:07 a.m.

AGENDA Moved by Director Greenaway
Seconded by Director Miller

AG.2016-5-1 "That the Agriculture Committee Meeting Agenda of May 26, 2016 be adopted."

(All/Directors/Majority) CARRIED UNANIMOUSLY

MINUTES

Agriculture Committee Meeting Minutes -April 28, 2016	Moved by Director Benedict Seconded by Director MacDougall
AG.2016-5-2	"That the minutes of the Agriculture Committee meeting of April 28, 2016 be received."
	(All/Directors/Majority) CARRIED UNANIMOUSLY

DELEGATION

AGRICULTURAL LAND COMMISSION – Frank Leonard, Chair; Dave Merz, Vice-Chair, North Panel; Kim Grout, Chief Executive Officer RE: Presentation

Chair Parker welcomed Frank Leonard, Chair, Dave Merz, Vice-Chair, North Panel and Kim Grout, Chief Executive Officer, Agricultural Land Commission.

Mr. Leonard provided a brief history of his background. He worked in local government for 28 years and was a business owner and operated a tire shop. He also teaches a Small Business course in Victoria. He mentioned that Ms. Grout was named Chief Executive Officer of the Agricultural Land Commission in December, 2015. Ms. Grout has a farming background and a degree in Agrology and has also worked in local government.

Mr. Leonard and Ms. Grout provided a PowerPoint Presentation.

Agricultural Land Commission (ALC)

- ALC is an Independent administrative tribunal;
- Carries out mandate set out in *ALC Act*;
- Interprets & applies the legislation written by gov't.

Sec. 6 Purpose of the ALC Act

- Preserve agricultural land;
- Encourage farming on agricultural land in collaboration with other communities of interest;
- Encourage local governments, First Nations, the government & its agents to enable & accommodate farm use of agricultural land & uses compatible with agriculture in their plans, bylaws & policies.

The ALR – It's A Finite Resource in BC

- **What's Out?** – 95% of the land base;
- **What's In?** – 5% of the land base;
- **Total Area:**
    - ALR +/- 4.6 million ha.
    - BC +/- 94.0 million ha.

The ALR in BC

- Land Area of B.C. - 100%;
- Agricultural Land Reserve (ALR) – 5%;
- Land in ALR Suitable for a range of crops – 2.7%;
- Prime agricultural land in ALR – 1.1%.

DELEGATION (CONT'D)

AGRICULTURAL LAND COMMISSION – Frank Leonard, Chair; Dave Merz, Vice-Chair, North Panel; Kim Grout, Chief Executive Officer RE: Presentation (CONT'D)

ALR Area by Region

Region	ALR Area (hectares)	Percent ALR Area
Okanagan	224,977	5%
Island	116,207	2%
South Coast	148,207	3%
Interior	1,528,968	33%
Kootenay	392,557	8%
North	2,210,783	49%
Total	4,621,699	100%

Bill 24 – ALC Act Changes
- September 5, 2014 – Came into force;
- Split ALR into two zones (Zone 1 and Zone 2);
- Legislated 6 independent panels;
- Role of the Chair defined;
- Section 4.3 new considerations in zone 2 (economic, cultural and social values).

Zone 1 and Zone 2 Panels
- **Zone 1:**
  - South Coast;
  - Island; &
  - Okanagan.
- **Zone 2:**
  - Kootenays;
  - Interior; &
  - North.

Section 4.3 of the ALC Act
- When exercising a power under this *Act* in relation to land located in Zone 2, the commission must consider all of the following, in descending order of priority:
  (a) the purposes set out in Section 6;
  (b) economic, cultural and social values;
  (c) regional and community planning objectives;
  (d) other prescribed considerations.

ALC Governance Model
Chair
- North Panel;
- Interior Panel;
- Kootney Panel;
- Okanagan Panel;
- South Coast Panel;
- Island Panel.

Full Commission = 19 members;
6 Regional Panels = 1 Vice Chair + 2 Commissioners;
Executive Committee = Chair + 6 Vice Chairs;
Chair.

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DELEGATION (CONT'D)

AGRICULTURAL LAND COMMISSION – Frank Leonard, Chair; Dave Merz, Vice-Chair, North Panel; Kim Grout, Chief Executive Officer RE: Presentation (CONT'D)

Chair Oversight – Application Process
Refers all applications:
- Region Panel;
- Executive Committee (EC);

Reviews all panel decisions (within 60 days)
- Re affirms decision;
- Directs EC to reconsider.

Chair Oversight
- Authority to refer a particular application to the Executive Committee within 60 days of a decision for reconsideration:
  - If believes may not fulfill the purpose of Section 6;
  - Does not adequately take into consideration the considerations set out in Section 4.3.

Executive Committee
- Chair and six Vice Chairs;
- Responsible for:
  - deciding applications referred by the Chair;
  - deciding applications referred by a regional panel;
  - making reconsideration determinations;
  - exercising any other functions delegated by the Commission (i.e. annual reporting).

The Full Commission
- Develop policies governing the Commission, pass resolutions and bylaws re: conduct of its affairs;
- Recommend legislative or regulatory changes to Gov't;
- Determine ALR boundary;
- Ensure local government land use planning is compatible with agricultural use of ALR;
- Develop policy that encourages agriculture.

ALR Regulation Changes
- Government amended the regulations in 2015;
- Amendments include:
  - Medical marihuana production permitted;
  - Farm retail & processing permitted by a Co-operative Association;
  - Breweries, distilleries and meaderies permitted provided the 50% farm product input;
  - Able to lease a portion of a farm for farm purposes.

Local Government Partners
- Local governments, regional and municipal, are partners in agricultural land preservation;
- First step in application process;
- Adopt supportive land use plans, policy, and bylaws;
- Work together to achieve compliance.

75% of the ALR is under local government jurisdiction.

DELEGATION (CONT'D)

AGRICULTURAL LAND COMMISSION – Frank Leonard, Chair; Dave Merz, Vice-Chair, North Panel; Kim Grout, Chief Executive Officer RE: Presentation (CONT'D)

2016/2017 Budget Lift

- $1.1M (33%) base-budget increase to better support:
    - regional panel decision making process;
    - planning work with local governments;
    - compliance and enforcement.

Fee Changes – effective April 1

- **Application Fees:**
    - Zone 1 - $1,500 (LG portion $300);
    - Zone 2 - $900 (LG portion $300);
- **New Service fees for approved applications:**
    - Document review fees: $150 per document;
    - Site Inspection fees: $350 per inspection;
    - Monitoring fees: $500 - $2,000 annually.

ALC Performance Targets

- Making decisions within 60 business days;
- Refund of ALC fee portion after 90 business days;
- Developing comprehensive compliance and enforcement approach;
- Increasing engagement with local & regional governments & annual survey;
- Annual client survey.

Mr. Leonard noted that he would be willing to return to the region to meet with stakeholders and or interested parties in regard to agriculture and the ALC.

Discussion took place regarding the addition of six officers plus administration support to the ALC. The ALC is currently working on providing compliance officers throughout the province and not just in the Lower Mainland. Mr. Leonard spoke of the ALC working with local government and improving relationships to improve and encourage agriculture.

Chair Parker brought forward the issue in regard to planting trees on agricultural land by foreign companies to meet carbon offset initiatives. Mr. Leonard noted that the issue has been brought forward to the Minister of Agriculture. The ALC has recommended a legislative change to the provincial government in regard to planting trees on farm land and making it a non-farm use application process. Director Miller mentioned the importance of continuing to address the issue.

Mr. Leonard spoke to the process in which the ALC reviews the information it receives in regard to an ALC application. Mr. Leonard mentioned that the panels receive the report that is similar to what the Regional District reviews. They do not have a staff report attached but do receive a background historical report of the property: if there have been previous applications in regard to the property and past decisions made. Once the panel has made a decision and the Chair reviews the report he also reviews the local government reports. Ms. Grout noted that in her observations the panel is reviewing the applications and looking for board recommendations and an alignment with the local government Official Community Plans (OCP). She noted the interest by the ALC to become a part of the planning stages of local government OCP's and also with the Minister of Agriculture to create alliances and collaborate in regard to shared interests.

AGRICULTURAL LAND COMMISSION – Frank Leonard, Chair; Dave Merz, Vice-Chair, North Panel; Kim Grout, Chief Executive Officer RE: Presentation (CONT'D)

Director Miller spoke to the Bill 24 *Agricultural Land Commission Act* changes in regard to the split of the Agricultural Land Reserve (ALR) into two zones – Zone 1 and Zone 2 and the Section 4.3 new considerations in zone 2 including economic, cultural and social values. He noted that the economic, cultural and social values are not defined in the legislation. Ms. Grout commented that the panels are deliberating on all community objectives and plans and are wanting to make decisions in a collaborative manner to reserve, with preservation and long term vision, in line with the ALC focus. The ALC panels deliberate about the long term requirement under the *ALC Act* to preserve agriculture land, and is the continued priority recognizing there is community needs and objectives that come secondary to preserving agriculture. There is not a prescribed procedure or definition in deliberation and consideration of the economic, cultural and social values. It is decided as a tribunal and in zone 2 they have to provide written consideration of those values wherein zone 1 they may deliberate in regard to the values but there is no written obligation to include it in the panel's decision.

Director Repen brought forward concerns in regard to the mandate of the ALC to develop policy that encourages agriculture and yet there is a lack of ALC staffing in the region to be able to assess and determine the development of agriculture in the province. He noted that it is challenging for farmers to be able to afford to be on the land base. Director Repen spoke to the need to investigate and support smaller lots and younger farmers in order to encourage farming. He also brought forward the need to investigate the soil values and potential land use to determine what best can be grown and sustained in the region to mitigate the need to import products. Mr. Leonard mentioned that there are concerns also with allowing smaller agricultural land parcels and that the panels have completed application site visits to assist in determining the best decision in regard to an application. Mr. Leonard spoke of the panels making the best decisions based on the preservation and promotion of agriculture throughout the region and province.

The ALC is meeting in the Fall of 2016 to discuss planning and policy moving forward including defining the role of the ALC in the province.

Director Thiessen spoke of concerns of individuals purchasing large parcels of agricultural land that was/is growing crops but the purchaser does not intend to use the property for agricultural purposes. There are also issues with agricultural businesses being developed outside of communities to avoid community taxation and zoning bylaws and then requesting services from the community once the business is established. Director Thiessen questioned how the ALC and the ALC Chair visualize its role and understanding of agricultural needs in the north along with encouraging and enhancing agriculture in the north.

Mr. Leonard commented that in the past decisions were made by individuals from around the province wherein now decisions are made for the north by the North Panel which consists of two individuals from the Peace Region and one from the north. In 2015, Mr. Leonard as ALC Chair reviewed two percent of the applications that the ALC received. In moving forward his vision is to have compliance staff and planners in the region with office hours interacting with local government staff and the public. Director Thiessen spoke to the importance of having ALC staff interact and engage with local government.

DELEGATION (CONT'D)

AGRICULTURAL LAND COMMISSION – Frank Leonard, Chair; Dave Merz, Vice-Chair, North Panel; Kim Grout, Chief Executive Officer RE: Presentation (CONT'D)

Chair Parker mentioned that when the ALC has its planning meetings the RDBN would be willing to provide a representative to provide input in moving forward. The recognition of the need to create a better staff to staff relationship between the ALC and local government is very important. He also spoke of the importance of Mr. Leonard and Ms. Grout spending time and touring the region to be able to get an assessment of the agricultural needs and wants of the region. Chair Parker noted that the RDBN Agriculture Committee could arrange a tour of the region.

Chair Parker thanked Mr. Leonard, Mr. Merz and Ms. Grout for attending the meeting.

ADJOURNMENT — Moved by Director Benedict
Seconded by Director Greenaway

AG.2016-5-3 — "That the meeting be adjourned at 10:59 a.m."

(All/Directors/Majority) — CARRIED UNANIMOUSLY

Mark Parker, Chair

Wendy Wainwright, Executive Assistant

OUTLINE

Preamble and acknowledgements

How this manual was developed….to be filled out in partnership with BCFC

CHAPTER 1 – INTRODUCTION TO RESEARCH

What is Demonstration Research?

Before we can discuss 'demonstration research' we must first outline the difference between traditional demonstration and research. Typically, demonstration plots are used by Extension agents or Agriculture businesses to demonstrate the benefits of using a new practice or product. The science behind the new practice or product has already been tested and demonstration plots are installed to show the local producers what could be expected by adopting the new practice or product. Research plots are part of hypothesis driven experiments that follow somewhat standardized protocols that include replication and randomization.

What is demonstration research (DR)? Within this document, DR refers to using a combination of demonstration styled plots with some research-type elements to answer a simple question with some confidence. The benefit of DR is that it is producer directed, it can be carried out independently, and it uses the resources typically available on-farm. Demonstration research allows a producer to use a small portion of their land to test and identify ways to better manage their resources in order to increase productivity, or achieve other farming goals they may have.

While the results of DR are not intended to be published or undergo rigorous statistical review, it is important to understand some of the foundations of research and how variability influences results in order to achieve the best results with your demonstration research.

On the following page is a condensed diagram of the sections of this manual, a brief statement of what is covered in each section and reference pages for each section.

Demonstration Research Manual in a Nutshell

Chapter 1 →	**In an armchair!** How DR helps you tease out natural variability from treatment effects	Pages ---
Chapter 2 →	**At the kitchen table!** Lots of planning and organizing will ensure you are ready to implement your customized DR	Pages ---
Chapter 3 →	**In the field!** All the details of DR lay out, installation, data collection; as well as what to do if things go wrong!	Pages ---
Chapter 4 →	**Back at the kitchen table!** Pull out your calculator and analyze your data to see your treatment effects	Pages ---
Chapter 5 →	**In a chair, at the table and in the field!** Double-check check list and things to think about while conducting your DR	Pages ---

Principles of research

Research is about predicting future responses. For example, rather than observing that Variety A outperformed Variety B last year; research allows a farmer to state **with confidence** that it is highly likely that Variety A will outperform Variety B **every time** they are planted under the same conditions. One of the challenges of demonstration research is to sort out the true effects caused directly by the treatments applied versus those effects caused by "background noise".

Sampling, Replication, and Variability

How well a population can be represented by a sample depends on the sample size. The larger the sample size, the better it will represent the population. For example, if you are researching a population of 1,000 individuals, would you trust one person, chosen at random, to provide an accurate, representative measurement of the entire population? Chances are that the individual would not accurately represent the population. What if your sample contained ten people randomly chosen from the population? That would be better than the one, but not as good as a sample of 100 people. As the sample size (or number of people) gets closer to the size of the population, the sample will more accurately represent the population. The only way to get completely accurate results is to measure every individual in a population; however this is a time consuming and costly endeavour. Therefore, we sample populations and make the assumption that if we sample enough, we will have a fair representation of the whole population.

We also have a potential issue related to variability. For example, if you conducted an experiment just once, you might wonder "did I get those results because it was a wet/dry/hot/cold year?", or "were those results specific to this field? What would happen if I conducted this research at different locations?" Therefore, an experiment needs to be evaluated more than once, or repeated (statistically known as 'replication'). There are different ways to replicate an experiment. One way is to have multiple plots at one location. Another way would be to conduct the experiment on many farms. And yet another way would be to conduct the experiment over time, performing it in multiple years.

Replication, helps to overcome the fact that any two plots under the exact same management (such as two small parts of the same field) will not have exactly the same yield, number of plants, weed population, soil fertility, or any other factor because of natural variability. In other words, replication helps you to determine if results are due to your treatments or due to naturally occurring variation. If one cropping practice is superior to another, the benefits will become evident if you compare the two practices many times, at many locations. In fact, the benefits of one practice to another has to be *significant enough* to overcome any effects of natural variability. Figure 1 demonstrates an example of how yield results can be affected by naturally occurring variability within a field. Within a seemingly uniform field, under identical treatments, there was up to 9 bu/acre difference between strips adjacent to one another, and upwards of 15 bu/acre across the whole field. In this example the variability may be due to differences in soil nutrients or moisture or some other factor.

As a farmer, you are likely interested in understanding how your research will perform at your farm specifically. Therefore, the simplest way to replicate your research is to repeat it for multiple years. By conducting the research multiple times, you can avoid wondering if your results were because of other factors such as 'it was a wetter/dryer year than normal'. The more times you repeat your experiment, the greater confidence you will have in your results.

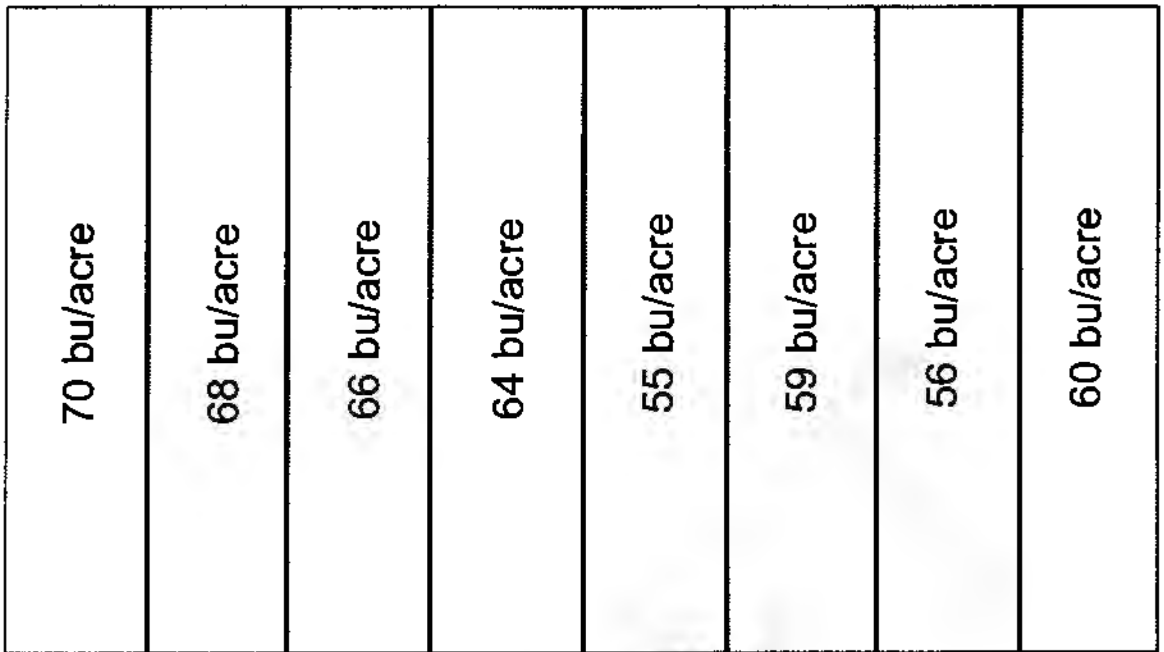


Figure 1 - Winter wheat yields (bu/acre) in eight side-by-side strips in a seemingly uniform field; demonstrating natural variability (From Veseth et al., 1999).

As Figure 1 demonstrates, there can be a lot of variability within any field due to factors such as differences in soils, topography, or historical management. It is not practical to try to avoid this variability because some level of variability will always be present; instead you can incorporate the variability in your DR and reduce its impact or 'smooth it out' by having large treatment areas. Generally, the larger, in particular longer, the treatment area is, the better the results are likely to be.

IF possible, 1000 ft or longer is recommended for each treatment.

Within this document, we will outline simple DR designs intended to test one treatment or management practice against another, or A versus B. Farmers wanting to design complex demonstration research or incorporate replication within their field are advised to consult a government agent, university researcher, or consulting scientist for guidance with experimental design and statistical analysis of data collected.

CHAPTER 2 – PLANNING YOUR RESEARCH

1. Why do you farm?
2. What objectives will help you reach your farming goals?
3. How will you answer your research objectives?
4. What resources do you have to work with?
5. What will your research look like on the landscape?

A farmer's experience and observations are critical in problem solving and the development of new procedures and practices. Demonstration research compliments experience and observations by incorporating some research design elements while allowing you to work independently (i.e. – without depending on a research scientist). When you conduct demonstration research you are in every sense of the word a 'researcher'. Your results may ultimately guide you through a series of changes in how you manage your farm.

While DR can yield important information, it is not without challenges. Conducting research that produces applicable information requires discipline and patience. The success of your demonstration research trial will depend initially on how well it's planned, and ultimately, how well you follow your plan. Even a simple research project takes time to plan - don't underestimate this stage of the project.

Within this section of the manual, there are multiple worksheets and project development activities. The more time you spend in thoughtful preparation the better your results will be!

2.1 Farming Goals – WHY do you farm?

Before you can ask a research question it is important to sit down and consider what you want to accomplish, not just with the research, but in life, or at least on your farm! The thought process of mapping out your farming goals is not an easy one. It may take some time conceptualize your goals. Once your goals are established, then you can develop objectives that will help you reach your goals. Often, researchers interchange 'goals' and 'objectives'. While both are very important for successful research, one must clarify goals versus objectives before getting started because goals without objectives can never be accomplished; while objectives without goals won't allow you to reach your long-term vision.

a. Goals: All of us have lifelong goals that guide us through our daily lives. Generally, goals are vague and distant; they encompass a desire or thought. For example, you may have a goal to be a full-time farmer. This goal does not incorporate any concrete, or tangible tasks about how you are going to become full-time farmer – that's where Objectives come in!

b. Objectives: In order to achieve one's goals it is important to put objectives in place. Objectives are S.M.A.R.T: Specific, Measureable, Achievable, Realistic and Time sensitive! In this way, the overarching goal can be divided into small, piece meal objectives that come together to support the larger goal(s). Objectives will be covered more thoroughly in the next section – Developing Objectives.

Before moving forward, spend some time developing your farming goals (**Activity #1, Worksheet #1**). Do you want to increase your herd size without buying/leasing more land? Do you want to generate enough revenue from your operations that you can farm full-time? Goals will change overtime. Ideally, you will create new goals as you attain your current goal. As you move through the process of developing your demonstration research, ask yourself – "how will this information help me reach my goals?" You may find that your research needs to be adjusted in order to support your farming goals.

ACTIVITY #1 – GOAL SETTING

Goal setting requires creative thinking; they reflect your values and beliefs, the resources you have and the opportunities/limitations that you face.

Adapted from: http://agebb.missouri.edu/mgt/settingfandfgoals.htm

Step 1. To determine where to go in the future, assess your past.
Review some recent decisions, and ask yourself:
Why did I do that? Did the decision move your business in the right direction? If so, did you plan it that way, or did it just work out in your favour?
This step will get you thinking about your decision-making process.

Step 2. List your goal(s) ..... it is important to write them down (Worksheet #1)!
This is the 'big picture'. Where would you like to see your farm in 1 year, 5 years, 10 years, and in the next generation? Your goals for your farm should fit in with your life-style and take into account your resources and limitations. If your goals are too hard, time consuming, or too expensive you may quit before you reach them.

Step 3. Prioritize your short-term (1-10 years) and long-term (10+ years) goals.
Priorities can provide clear guidelines for management decisions, similar to a business plan. To help set goal priorities, ask yourself these questions:

- Which goals are most important for family success?; for farm success?
- Which short-term goals, if acheived, would help meet long-term goals?
- Which short-term goals do not support any long-term goals?

Step 4. Assess farm resources and limitations (Worksheet #2).
This step helps you decide what you have to work with in your planning. A list of farm resources could include:

- The land inventory (acres, quality)
- The farm labour supply (will you need extra help to conduct your research, outline your busiest times of the year)
- Tangible working assets (machinery, equipment)
- Money and management (funds available, skills available, skills that would need to be purchased/aquired)

It is important to balance the potential payback or benefit with the likely costs of your goals. Having a rough inventory of your farm resources will allow you to ensure that your goals are achievable given your resources.

Step 5. Make plans for action......demonstration research design!
Action without planning is fatal; planning without action is futile. Given your goal, how do you intend to get there from here? Demonstration research can be a valuable tool to assist you to reach your farming goals.

WORKSHEET #1 – DEVELOPING AND PRIORITIZING GOALS

What do I want?
Farming Goals

Short-term 1-10 years	Long-term 10+ years
Priority ☐	Priority ☐
Priority ☐	Priority ☐
Priority ☐	Priority ☐

***Review your farm resources
and **prioritize** your goals

***Select one Goal and start planning now to gather the resources you will need!

WORKSHEET #2 – ASSESSING YOUR RESOURCES

Land	How much do you have?
	How much can you risk?
	Best candidate field(s)?
Labour	How much do you have?
	Will you need to hire help?
	When is your busiest time?
Equipment	What do you have available?
Money & Management	Will you need help and when?
	Do you have the funds to risk?
	Purchase/borrow equipment?

2.2 Developing Your Objective - WHAT do I need to reach my goal?

After assessing your short- and long-term goals as well as your available resources, you are ready to start developing objectives that support your farming goal(s). Remember that objectives are S.M.A.R.T. When developing objectives it is important to keep it simple, simple, simple. You will not be able to achieve your farming goals with one complicated objective. Therefore, focus on just one achievable and clear objective per demonstration research trial.

For example, if your goal is to become a full time farmer then one of your objectives could be to produce greater yields without purchasing more land. In this example, it is clear that *yield* is the 'measurement' associated with your objective – recall that objectives are <u>measurable</u> while goals are not.
The measurements associated with each objective need to be thoughtfully developed.

2.3 Developing your Research Question(s) – Answering your objectives

Demonstration Research requires time, energy and money. Complex trials involve more of each. The simplest questions involve a yes/no answer. Examples might include:

- was herbicide 'A' more effective versus herbicide 'B'?, or
- did variety 'A' perform better than variety 'B'?, or
- are my yields affected with a low versus a high seeding rate?

When developing your research question, it is important to revisit your farming goals and objective(s). Recall our example: your goal is to become a full time farmer and your objective is to produce greater yields without purchasing more land. You may want to know "would I get greater yields with Fertilizer A or Fertilizer B"? This simple question is the foundation of your demonstration research. This question may lead to future questions such as, "do the yields associated with Fertilizer A outweigh the additional costs of purchasing Fertilizer A?".

Case Study:

A northern BC farmer wanted to decrease the time and money spent on harvesting and storing winter feed (Goal). In order to do this, he decided to increase the amount of good quality standing forage (kale) into the winter season (Objective). His preliminary Research Questions were:

1. *Can* I grow forage kale on my property?
2. *How* does the forage quality of the kale change through the fall and into the winter?

It is important that the Objective and Research Questions feed back into the Goal. In this example, the farmer can reduce 'tractor time' harvesting, storing and then feeding his winter feed. The more standing forage the cows consume the less the farmer needs to spend. However, the farmer needs to know if kale can grow on his farm, if the quality is suitable, and for how long the quality remains suitable.

The *measurements* made to answer his research questions were:

- Establishment counts of kale plants/acre
- Forage analysis of samples collected every 2 weeks from November 1 – December 15

The *resources* needed to answer his research questions included:

- Money to purchase forage kale seed and forage quality analysis services at a laboratory
- Seed drill suitable for small seed
- Time for seeding
- 3 hrs in the early summer to collect establishment data
- 2 hrs, twice a month throughout the fall and winter to collect samples and drive to town to send samples to lab
- Shipping materials and cost of shipping samples

Complete Worksheets #3 and 4 to develop objectives, research questions, measurements and resources needed.

WORKSHEET #3 – PRIORITIZING OBJECTIVES and DEVELOPING RESEARCH QUESTIONS

What measurable changes will help me reach my goal?
'These are Objectives'

What *specifically* do I need to test to answer my Objective?
'These are Research Questions'

Priority Goal for DR?

Objective 1

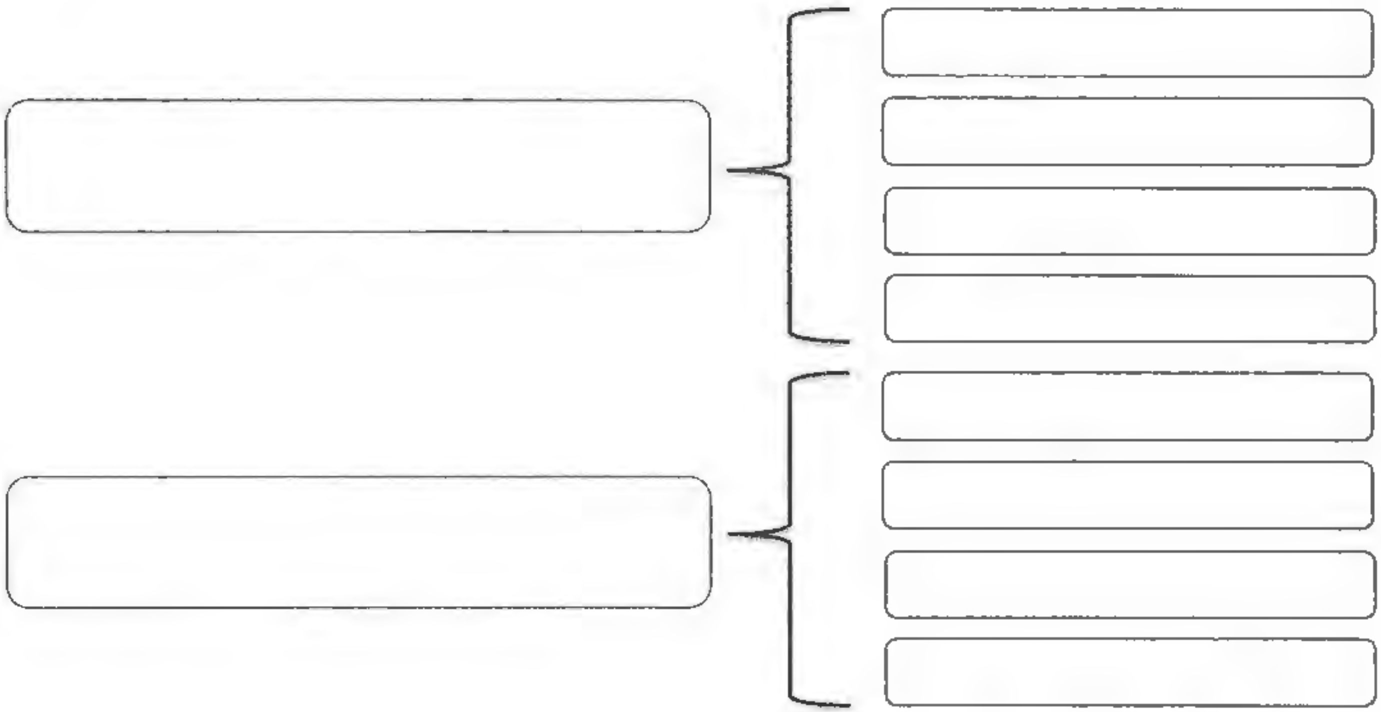
Objective 2

***Review your farm resources and **prioritize** your objectives

***Start planning now to gather the resources you will need!

WORKSHEET 4 – MEASUREMENTS TO TAKE AND RESOURCES NEEDED

What measurements will answer the Research Question?	What resources are needed to make the measurements?



***Start planning now to gather the resources you will need!

2.4 Assessing Research Capacity – WHAT do I have to work with?

Before you can begin designing your research, you need to assess your capacity critically. What do you have at your disposal? How much time do you have? Will you need to purchase any equipment? How much land do you want to allocate towards your research? Can you complete all aspects of your research using existing equipment? What are the dimensions of your farm equipment? Will you avoid variability or incorporate it? These are just some of the questions that should be sketched out on paper at the kitchen table ahead of time being certain to incorporate the factors outlined below.

i. *Accounting for equipment dimensions*

As you design your demonstration research, keep in mind the dimensions of the equipment you plan to use. You can sketch out your treatment areas based on your existing equipment to minimize any errors. For example, you have a 20 ft seeder, a 10 ft harvester and a 40 ft fertilizer spreader. You will need to ensure that your treatment areas are designed based on the largest piece of equipment you are planning on using. Because your fertilizer spreader is 40 ft wide, each treatment area should be in multiples of 40 to prevent fertilizer overlap.

ii. *Accounting for equipment variability*

All equipment has some level of variability inherent to its design and condition. For example, the nozzles on a fertilizer sprayer will not spray an equal volume across their range and this error will be compounded as nozzles become worn and damaged (See Figure 2). Therefore, sprayers are designed to overlap the outer spray zones of each nozzle. That being said, the nozzles on either end of the sprayer will have reduced output on their outer edge.

Therefore, be sure that the treatment area is wide enough to allow for at least two passes of your widest piece of equipment, this will ensure that any inconsistencies at the end of the equipment are taken into account.

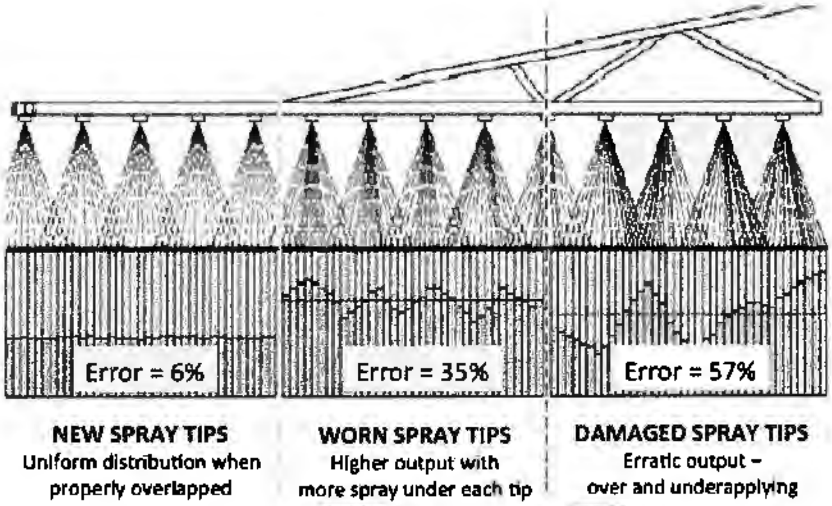


Figure 2 - Adapted from Oregon State University, Weed Science Lab Manual (CSS 540)

iii. *Accounting for field variability*

The area being used needs to be large enough to account for variability within your fields. As is demonstrated in Figure 3 (and Figure 1), there is a lot of natural variation within a 'uniform' field. Lack of uniformity can be a function of soil characteristics, topography, aspect, or past management. In Figure 3, we see that percent moisture content ranges from 13.5 to 17.0% across a flat, uniform field. Whatever the factor, non-uniformity will translate into variability within and between your treatments. This variability is 'background noise' that has nothing to do with your treatments but could lead to incorrect results.

Therefore, it is prudent to ensure that your treatment areas do not include bizarre landscape features. You can even intentionally skip a saline patch or avoid a hummock. However, it is critical that you place your treatments in areas that are truly representative of the majority of your farm – discussed below

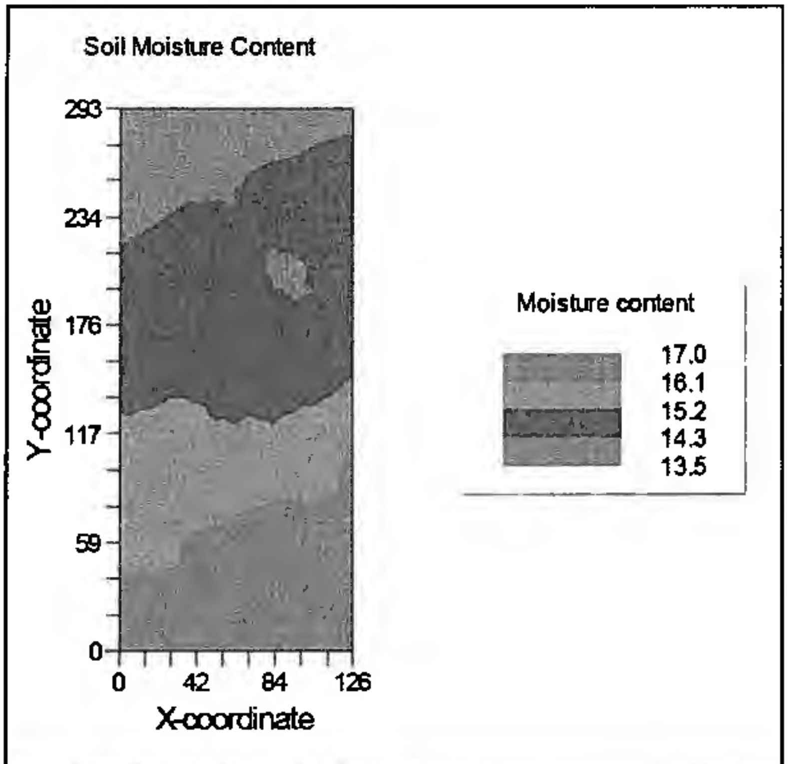


Figure 3 – Example of soil moisture measurements taken from a uniform agricultural field in North Dakota (slopes of 2-3% and sandy loam soils). From: Jabro et al. USDA

iv. *Ensuring treatment areas and fields are representative*

While it is tempting to pick the flattest, most uniform section of the flattest field, it is important to ensure your results will be transferrable to other parts of your farm; or at least somewhat representative of your farm. If 90% of your land is sloping, then it would be wise to incorporate slope into your design so that you have an idea of results to expect *across* the landscape. Slope (or any other variability) does not need to be avoided in your demonstration research design; however, variability does need to be incorporated consistently across all treatments areas. In other words if in our example, Fertilizer A is spread in an area with a south facing slope, Fertlizer B should also be spread in an area with a south facing slope and not on the flat area.

v. *Ensuring field variability is consistent across all treatments*

We know the importance of considering non-uniformity when choosing where to locate your treatment areas. If you know that your field is non-uniform in terms of slope, soil type, or any other factor then try to incorporate all aspects of the non-uniformity into all the treatment areas. For example, Figure 4 outlines the correct and incorrect way to lay-out a treatment area on sloping land. The 'wrong' lay-out will ensure that the top treatments are consistently drier than the bottom treatments. Whereas the 'right' lay-out incorporates the slope and its associated variability into each treatment. Although it is not appropriate to till up and down slopes, demonstration research strips should be laid out up and down slope and not across them in order to make the effect of slope as uniform across all treatments as possible.

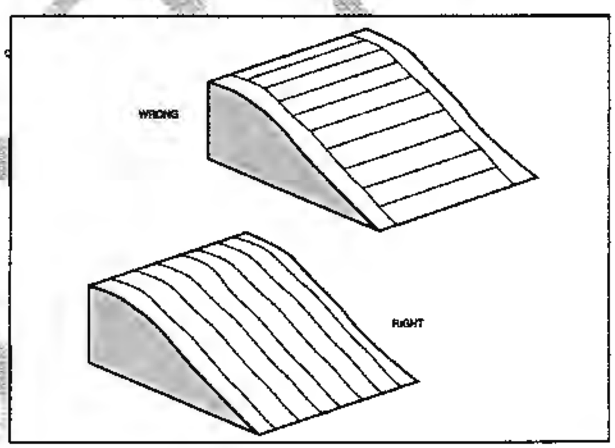


Figure 4 - An example of a correct and incorrect treatment area lay-out on sloping land, the goal is to equally incorporate the slope in each treatment strip.

2.5 Designing the demonstration – WHAT will it 'look like'?

i. Treatment area size (an example)

After working through sections 2.1-2.4, you decide that:

- four passes with fertilizer will result in a more uniform application than just one pass (recall Figure 2). In order to have 4 passes, each treatment area will have a width of 160 ft because your spreader is 40 ft wide.
- Ideally each treatment area should be 1000 ft long to ensure that you harvest enough to capture a true representation of the variability across the field.
- You also decide that incorporating slope into your Demonstration Research is important because most of your fields are sloped.
- Therefore, you will need a total area of 320,000 ft^2, or 7.34 acres (160*2*1000).

ii. Treatment area lay-out

- You will want to ensure that your treatments are not close to a forest edge, windbreak, building, or other structure that will affect your research results. Ensure that you (and/or your livestock) will not need to travel through your treatment areas in order to access any other fields, pipes, gates, or other resources. Take your time during this stage, make sure that your treatments are in the best location and are easily accessible.
- Additionally, ensure that there is enough room around your treatment area for your equipment to turn and get up to speed for the next 'pass', do not turn or slow down within your demonstration research area. You want to

ensure that your equipment is running at the same speed within the treatment area or you will add variability to your results through inconsistent seeding, fertilizing, spraying etc. See Figure 5 for a bird's eye view example of how the treatment area might look on the landscape.

- Take some time and sketch out your Demonstration Research lay-out (Worksheet #4) similar to Figure 5. While the lay-out may eventually change, drawing your DR ahead of time ensures that you spent time considering landscape and land management attributes. Be sure to make at least 2 copies of your layout.

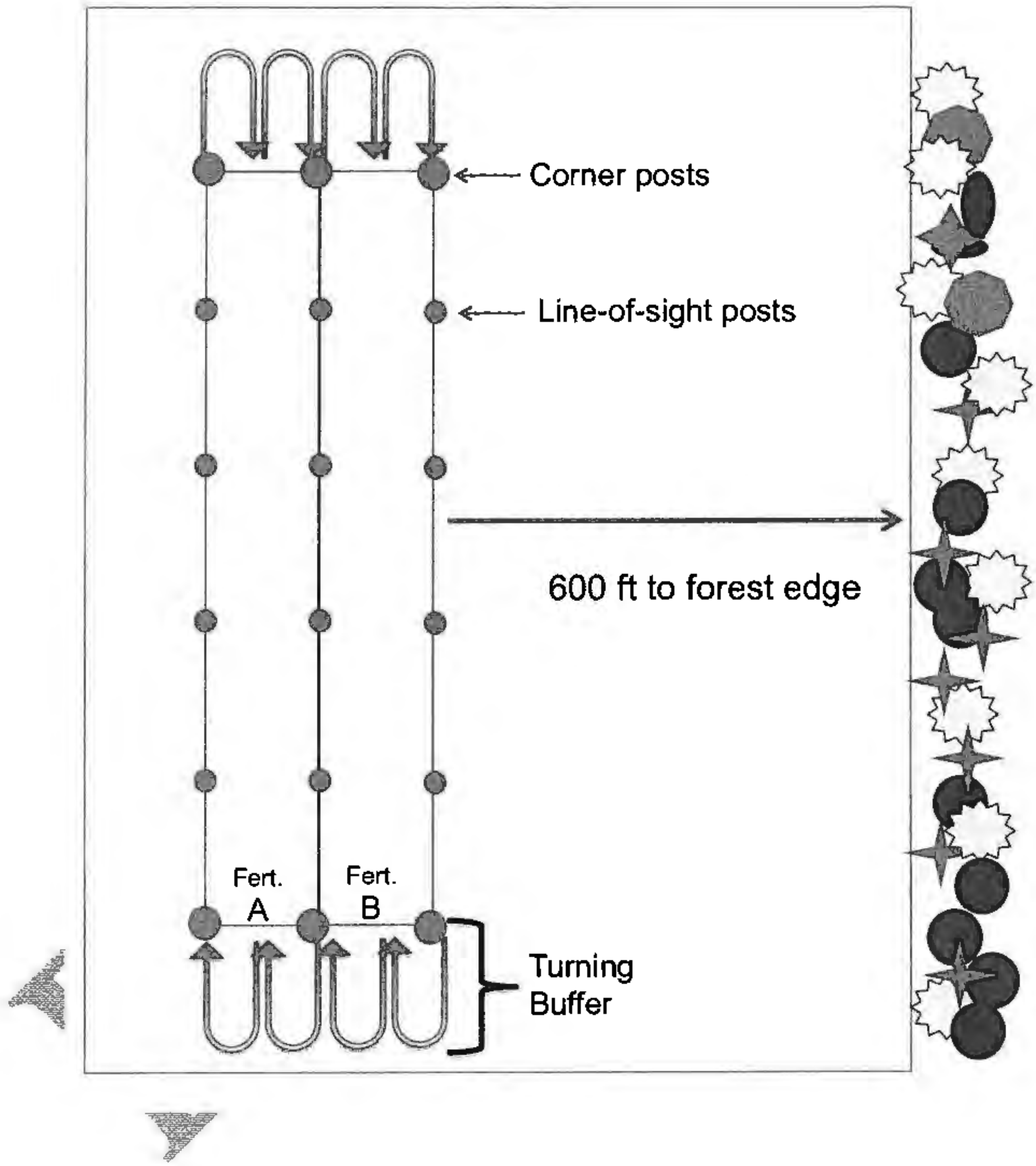


Figure 5 – Example of treatment area lay-out on the landscape within the proposed field

WORKSHEET #5 – POTENTIAL TREATMENT AREA LAY-OUT

Remember to draw your DR lay-out with a bird's eye view. Try to consider all your operational needs as well as landscape features that could affect your results

iii. How to take measurements?

- Recall that your Objectives need to be measurable! Your original Research Question was "would I get greater **yields** with Fertilizer A versus Fertilizer B". Therefore, the measurement is yield. There are different ways to measure yield and these can vary with the type of crop you are growing. If you are producing hay, when you harvest your treatment areas, you could simply count the number of bales from each treatment area and multiply that by an assumed bale weight. This would be the least accurate option but it might be within your capacity, given your available resources (which includes time). The next option would be to weigh each bale and add up the total weights. This would require a bale scale but would give more robust results. However, there will be some error as your approach the edges of your treatment areas. The third option would be to take many smaller samples within each treatment. This third option would result in the greatest accuracy as each sample is weighed independently and would allow you to avoid the edges of your treatments. Sampling also allows you to clearly see how much yield variability occurs within your field. You might find that Fertilizer A only produces greater results on the moister, lower slopes of your field! However, sampling is a much more time consuming process because it often requires small areas to be manually cut. As a result, it would be important to ask yourself - do you have the labour resources?

iii. How many measurements to take?

- If you choose to sample the whole treatment area and count or count and weigh your bales then you have sampled the whole population and you have one measurement per treatment area – the total yield of the area.
- If you choose to sample within each treatment area then you need to decide how many samples are required. The number of samples will hinge on the amount of variability within your field. However, a good rule of thumb is 10 samples within each treatment area.

While you have chosen a simple question – to compare Fertilizer A versus Fertilizer B, you have gone through a series of thoughtful questions and activities to ensure that your results will be as accurate as possible. Using Figure 3 as an example, your DR may look similar to Figure 5.

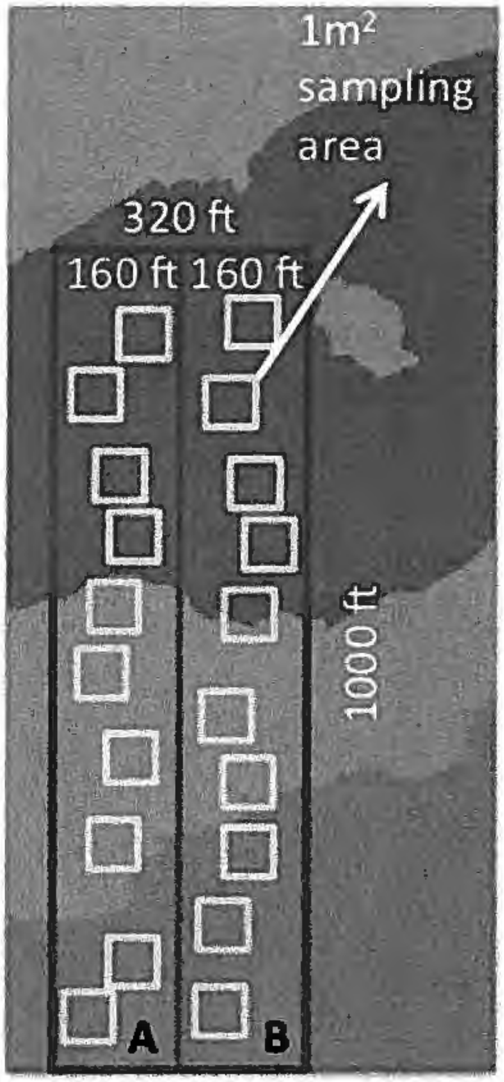


Figure 6 – Possible Demonstration Research design for comparing yields under two fertilizer treatments (A versus B) across moderately variable soil moisture conditions. Note that the very dry upper portion has not been included in the treatment areas. Figure not to scale, the sample areas are over represented on this diagram

2.6 Preparing to collect data

In order to know if your treatments are producing *real* (rather than perceived) differences you need to collect data. Data is simply a number of measurements that will allow you to see trends or differences between your treatments.

Designing your field data sheets ahead of time will ensure that you are collecting the correct data, that you have a structured and practical method to collect the data, and that you have a notebook or other recording option allocated for data collection.

When designing your data collection sheets think of the data that will be collected for example, number of bales and average bale weight, as well as other relevant information that will provide insight into your results as you move forward in the process. Basic information that should be included in all field data sheets is date, weather, the name of person collecting the data, and an area for general comments at the bottom of the data sheet.

An example of a field data sheet that could be used for the scenario in Figure 7 to record data in the fertilizer comparison research is on the following page. More example data sheets are included in Appendix 2.

Activity	Date		Sample size: 1m^2							
Seeded Field:	June 1		Crop: Alfalfa							
Field Sampling:	July 15		Harvest: First							
Field Data Form										
Information Collected By:										
	Weight of each sample (grams)									
Treatment	Sample 1	2	3	4	5	6	7	8	9	10
Fertilizer A	121	123	119	120	122	126	148	165	158	160
Fertilizer B	120	124	120	122	130	120	122	121	130	123
Comments:	Samples 1,2,3, and 4 were in drier portion of field. Samples 7,8,9,and 10 were in wetter bottom slope of field. Samples 5 and 6 were in between									

Figure 7 – Example of a field data form with hypothetical data that could have been collected in the Fertilizer A versus B scenario outlined in Figure 6. Data presented in this figure will be revisited in Chapter 4 – Analyzing Your Results

CHAPTER 3 – Conducting YOUR DEMONSTRATION RESEARCH

3.1 Assessing your resources – do you have everything you need?

Before you make a single measurement, go through your list of required resources and make sure that you have everything you need for the complete field season. Also, check that your equipment is in good working order. Depending on your project, you may be constrained to a short window for planting/harvesting etc. and you need to be sure that your resources are ready when you are!

3.2 Laying out your treatment areas

It is important that you spend time laying out your treatment areas and marking them with highly visible corner posts. Ideally, you should be able to stand at one end of your treatment area and see the corner post of the opposite end. Each treatment area will need at least 4 corner posts. If you choose to use flagging tape to increase the visibility of the posts, neon pink flagging tape is among the most visible. Because the treatment areas are long (upwards of 1000 ft) you may decide to install treatment area divider stakes every 200 ft to give your eyes a line of sight. Ensure that the stakes are taller than your crop will be at harvest. Treatment areas should be laid out with 2 people to ensure that corners are square. If a treatment is within 100 ft of a structure, now is the time to move it to a new location! Windbreaks, buildings or forest edges will create shadows that affect growing conditions such as increased shade and soil moisture.

3.3 Check your equipment one more time

Recall the example in Figure 2 (Chapter 1) and how worn equipment can add a huge amount of variability to your results. Now is a good time to check the mechanics of your equipment and calibrate. Review your demonstration research design and ensure that the equipment you *planned* to use is same equipment you *are* using.

3.4 Installing your demonstration research

You are ready to seed, fertilize, spray etc. Go for it! You've done a lot of planning to get to this stage and you are well prepared. You will likely take your design map into the field. Have TWO copies of your design map; use one to take in the field, and keep the other in a safe place....you may need it later when your field map is worn and hard to read!

3.5 Timing your data collection

Depending on your research question, you may have multiple sampling dates through out the growing season or one sampling date at the end of the season. For example, the kale forage case study presented in Chapter 2 requires that the farmer collects samples through out the fall growing season. Therefore, the farmer needs to collect and ship kale samples on a regular basis. However, if your interest is final yield of forage oats then one sampling is done at the end of the growing season. Be sure that you have not overcommitted yourself. If you need to sample during the busiest time of the season, then have extra help lined up to ensure that neither your demonstration research, nor your livelihood are compromised.

3.6 Accuracy in your data collection

The devil is in the details! Think of the level of accuracy you need in your results to answer your research questions and ensure that the equipment and method of measurement is going to capture the level of accuracy you need. For example, if you are sampling the forage in ten, 1m^2 squares within each treatment area and weighing each bag individually, you will need a scale with an accuracy of 1 gram rather than a standard bathroom scale! More accurate data will

Ensure that each sample you collect is truly random and collected in the same manner as the previous sample. For example, if you are sampling productivity within a 1m^2 frame, throw the frame over your shoulder rather than looking for places to sample that you feel represent the condition of the treatment area. Be careful to make sure your random approach lines up with your question, if your sampling frame lands on a road, rocks or some extreme anomaly then it is appropriate to re-throw the frame. Also, if you are manually clipping crop samples, make sure you cut at a representative height and that each sample is harvested in the same manner. For example, you may decide to hand harvest your sample frame at 5-8 cm because that is the height your harvester cuts. Make sure that all your sample frames are harvested at 5-8 cm, with the same level of thoroughness (ie – be sure to gather up all cut stalks and place in bag for weighing)

As you see things in the field, write them down in a pocket notebook, then transfer the information to a more permanent record. Your recorded observations can lead to insights months – even years later.

3.7 Multiple sampling within your treatment areas

If you are sampling multiple times within your treatment areas you need to ensure that your sampling method is not affecting your results. For example, if you revisit your treatment areas many times during the season, walk the same path each time you access your treatment areas to ensure that any possible trampling is not affecting your results. Additionally, if you harvest a small amount each time you access the treatment areas, ensure that you are not resampling in the same spot and thus measuring re-growth rather than accumulated growth! Lastly, ensure are using a random sampling method to ensure that you are not over sampling one corner of your treatment area, or unknowingly biasing your results by selecting 'good patches' to sample. Random sampling is critical to ensure that your results are representative and unbiased.

An easy way to conduct random sampling is to determine your sampling method ahead of time. You might decide that you will sample every 100 paces, or generate GPS coordinates ahead of time and sample at those locations, regardless of what the area looks like when it comes time for sampling. Once you arrive at your sampling location don't forget to maintain your random sampling by throwing the sampling frame over your shoulder and sampling inside the frame – wherever it lands. However you decide to sample, ensure that your sampling method is random and unbiased.

3.8 Making changes 'on the fly'

Inevitably, 'things change' and all the planning that was done ahead of time needs to be modified 'on the fly'. Because your research is in the field there are a host of unforeseen circumstances that can arise. Making changes as you go along is a common research practice, there are just a few cautions to keep in mind when making changes on the fly. First off, revisit your goal, objective, and research questions. You may need to modify your research questions in order to complete the research; however, these modifications should still allow you to address your objective and goal. For example, with the Fertilizer A versus Fertilizer B scenario, what if you realized after applying Fertilizer B that the first two passes were the correct formulation, but then when you mixed a new tank of solution for the second two passes you added only half the fertilizer concentrate. Your error resulted in 3 treatments – Fertilizer A, Fertilizer B, and half strength of Fertilizer B. There is no need to remove the experiment. You can modify your research question from:

"would I get greater yields with Fertilizer A versus Fertilizer B?" to

"would I get greater yields with Fertilizer A versus Fertilizer B?" *and*
"Is there an effect on yields with half solution of Fertilizer B versus the full solution?"

Because there are now three treatments, you will need to increase your field sampling. But, you are still gathering the measurements you need to answer your original Objective – "to produce greater yields without purchasing more land" and have salvaged your demonstration research!

3.9 Use your field data sheets!

Revisit the field data sheets you developed during the planning stages. Make sure you use the data sheets and store them somewhere safe for the next stage.

CHAPTER 4 – ANALYSING AND INTERPRETING YOUR RESULTS

Recall that data collected from your Demonstration Research is meant to answer a very specific research (and management) question. Typically, the more data you can collect, the more insightful and meaningful your results will be. However, acknowledging that you are working under limited resources is critical to using the level of detail that is the most appropriate 'right here, right now'.

4.1 A Single Result

If you've decided to collect just one value, for example - total yield within each treatment area, it will be impossible to assess variability within your treatments. However, if you conduct the same experiment over and over, gathering a single yield measurement year after year then you have replication and can start to develop confidence in your results.

4.2 The Value of Sampling at the Correct Resolution

In 4.1 a single harvest yield doesn't provide much information about how natural variability within your treatment area might affect your results. In order to assess variability in your data you need to have multiple measurements; recall that 10 measurements from each treatment area is a good rule of thumb.

Let's recall our Fertilizer A versus Fertilizer B scenario. If assessing hay yields, you could weigh each bale within each treatment area and you might find that the total number of bales produced within each treatment area and corresponding yield (the sum of all the bales) is really no different. However, when you look at the number of bales harvested from the lower, more moist portions of the two treatment areas it appears that Fertilizer A might have produced one more bale than Fertilizer B; and in the drier area it looks like Fertilizer B might have produced an extra bale. But it is hard to tell because the area that the baler covers is so large. If you were to collect smaller samples within in each treatment area, you might be able to tease out if there is a difference in yield occurring in the more moist area.

Let's revisit the data presented in Figure 7 - Field Data Form

Table 1 – Yields (grams/m^2) from a side-by-side comparison of Fertilizer A versus Fertilizer B

	Sample weight (g/m^2)									
Treatment	1	2	3	4	5	6	7	8	9	10
Fertilizer A	1160	1180	1090	1100	1220	1260	1480	1650	1580	1600
Fertilizer B	1310	1280	1300	1320	1300	1200	1220	1310	1300	1230
Comments:	Samples 1, 2, 3, and 4 were in a drier portion of the field. Samples 7, 8, 9, and 10 were in the wetter bottom slope of field. Samples 5 and 6 were in between (not wet but not dry)									

If we look across all 20 data points we see there really is no difference between Fertilizer A versus Fertilizer B. The averages are very close and the ranges (the highest and lowest values) overlap.

Table 2 – Average yield and range from a side-by-side comparison of Fertilizer A versus Fertilizer B

Treatment	Average/m^2	Range
Fertilizer A	1332 g	116-165
Fertilizer B	1277 g	120-132

However, the comments section provides some very useful information! Recall Figure 3 that outlined the subtle differences in soil moisture in our example field. The famer has listed which samples fell in moist areas versus dry areas. If we separate the data based on the comments then we see a very different picture.

Table 3 - Average yield and range from a side-by-side comparison of Fertilizer A versus Fertilizer B on ***DRY*** sites

Treatment	1	2	3	4	Average	Range
Fertilizer A	1160	1180	1090	1100	1133	1090-1180
Fertilizer B	1310	1280	1300	1320	1303	1280-1320

Table 4 - Average yield and range from a side-by-side comparison of Fertilizer A versus Fertilizer B on ***MOIST*** sites

Treatment	7	8	9	10	Average	Range
Fertilizer A	1480	1650	1580	1600	1578	1480-1650
Fertilizer B	1220	1310	1300	1230	1283	1220-1310

In this example, we find that taking the smaller yield samples within the treatment areas gave us much more useful and insightful information! We can see that on drier sites Fertilizer B outperforms Fertilizer A, but on moister sites Fertilizer A outperforms Fertilizer B. This could easily lead to the farmer implementing a fertilizer program that is specific to soil moisture conditions. The farmer may be able to meet their goal of increasing yields without purchasing more land by tailoring their fertilizer choices based on soil moisture.

Refer to Appendix 1 if you are interested in how to expand the scope of your research and conduct statistical analysis of your data.

CHAPTER 5 – SUMMARY/CHECK-LIST

Review the following tips and summary statements one more time!

- ☐ Keep it simple, especially at first. Limit your project to a comparison of two treatments. As you gain confidence, try something more challenging

- ☐ Assess your resources and keep your demonstration research in-line with what you have available

- ☐ Plan, plan and plan. Spend time listing your goals, objectives, and research questions. Then, spend time sketching out your treatment design and preparing your field datasheets.

- ☐ Avoid pitalls. Test/inspect your equipment ahead of time, have help lined up for when you will need it, stick to your research plan and be willing to make changes 'on the fly'.

- ☐ Don't loose sight of your goals and objectives. Unexpected events happen in research, try to salvage your work and still answer your objectives.

- ☐ Stay consistent. Treat all experiments the same, avoid personal bias.

- ☐ Remain objective. The results may not turn out exactly as you'd hoped. Be prepared to learn from negative results

- ☐ Take lots of field notes. Observations in the field will provide insight into your results

- ☐ Don't ignore unexpected results. Sometimes an experiment will yield useful, yet unexpected, information. Unintended findings may prove to guide you towards new research or help explain the current results.

- ☐ Repeat, repeat, repeat. Repeat your experiment until you are comfortable with the results under varying conditions. You can repeat the experiment within one field, across many fields, and/or over many years. The more times you conduct the experiment, the more confidence you will have in your results.

Glossary of Terms

Average – basically, the average is the sum of all the numbers divided by the number of numbers. The average number is the value that represents all the others if you could take just one number from the group.

Background noise – the normal, or expected, natural variability within your farming system that will an affect on your demonstration research results. Variability in soil moisture across a field is an example of background noise that will affect your yields.

Data – a collection of facts, numbers, or observations (a dataset). In demonstration research, we typically use *quantitative data*, a collection of numbers (crop yield, protein levels, weight gain etc) that is used to determine if one treatment is different from another.

Effect – in demonstration research, the term effects is related to the treatments, and is the difference in the data results (more yield, higher protein levels, more weight gain etc) from your treatments

Measurement – in demonstration research a measurement forms the foundation of your dataset. A measurement could be the weight of one bale of hay, the protein level of a sample of alfalfa, or the weight gain over the season for a single cow. You need many measurements from a single treatment to form a dataset related to the treatment.

Plot – a plot is simply an area of land that is subjected to a single research treatment. The plot can be as small as $1m^2$ or as large as 100 hectares; however, the key is that a plot, or treatment area, has only one treatment.

Population – in demonstration research, the population is what ever we are interested in studying. For example, if you are interested in how well alfalfa responds to low versus high fertilizer regimes within a given field, then you have two populations in the field: alfalfa with low fertilizer, and alfalfa with high fertilizer.

Random – in demonstration research, the notion of randomness means that each member, or individual, from the population has an equal chance of being selected. It is critical that the individuals chosen are truly random because they will make up the dataset that is used to generate the average to represent the population. If individuals are 'selected' then we can't be certain that they are a fair representation of the whole population.

Sample – Very often it is not possible to study the entire population - it may turn out to be very expensive and also time consuming. Therefore, we measure just a portion of the individuals within the population. Those individuals (chose randomly) are the samples that make up the dataset used to represent the population.

Treatment – within demonstration research, the treatment is typically A versus B, or yes versus no. The treatment is what ever the researcher wishes to investigate; for example: fertilizer A versus B, or tilling versus no-till.

Treatment area – the treatment area is the area within a field that receives a single treatment. For example, a field is divided in half, one side is treated with fertilizer A and the other side is fertilizer B. Each half of the field is a treatment area.

Unbiased/Bias – bias is when a sample is collected in such a way that some individuals are more or less likely to be collected than others. When we are unbiased in our sampling method than we ensure the samples are a random representation of the population

Variability – within a dataset, variability is a measurement of how far spread out the data is. Variability of 0 would indicate that all the values in the dataset are identical. The greater the variability, the harder it is to have confidence in the treatment effects.

Still to come!

Chapter 6 – Case Studies from the Field

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Chapter 7 – Resources Available

Appendix 1 – Advanced Experimental Design and Analysis

Appendix 2 – Examples of Field Data Sheets