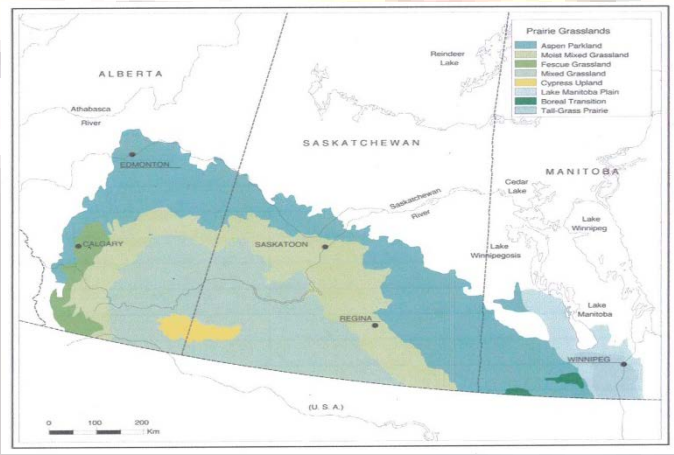
Rationale and Strategy

The primary focus of this feasibility study is to define an "X to Y" relationship between remotely sensed data (Normalized Difference Vegetation Index – NDVI) and pasture production with sufficient robustness and accuracy to form the basis for a pasture insurance program that is identical in concept to that available for annual crops. This requires the ability to measure pasture production at the individual farm level.[1] If results demonstrate the value of remote sensing as a pasture production measurement tool and generates interest from producers in this technology, then the study may be expanded to encompass a wider geographical area over an extended period.

In simple terms, the process required to measure cereal production includes the combine, truck, grain auger, grain bin and converting grain production volume to bushels or kilograms per acre harvested. These "measuring tools" are ubiquitous across regions but produce different production results by year, geographical region, management practice, soil types, weather conditions, etc. Insurance programs based at the individual farm level may differentiate "start-up coverage" and set premium using these broad characteristics. For example, coverage and premium may initially be based on homogeneous risk areas and differentiated by significant management practices such as seeding a crop into stubble versus a fallow field. However, the main driver in setting coverage and assessing losses is the actual production measured year-to-year at the individual farm level. Any production value could occur on any farm and/or within any geographical region. Over time, expected production that forms the basis of an agriculture insurance program is differentiated by area and/or farms within an area.

If remotely sensed data (e.g. NDVI) can measure pasture production on the individual farm, the results could be used to set coverage and assess losses. As with annual crops, we can expect to find and utilize homogeneous areas of pasture growth within the study that might be comparable to risk areas. And, as with annual crops, we would expect different levels of production across regions, broad pasture types and between farms. However, the measuring tool itself (the relationship between NDVI and pasture production) should have equal applicability across broad pasture types (see figure 1).

Figure 1: Broad pasture types identified for the project



[1] This study operates in cooperation with AFSC and will focus on native pasture with a minor test on hay production and verification of satellite-based "forage masks".

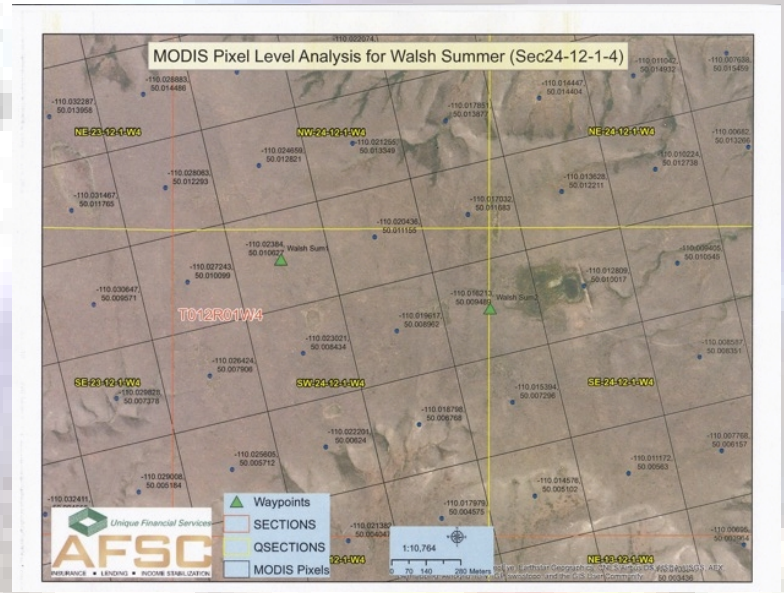
As with annual crops, any production value (NDVI) could occur on any farm and/or within any geographical region. And again, over time expected production that forms the basis of an agriculture insurance program is differentiated by area and/or farms within an area.

Data

Remotely sensed data is available in a variety of formats (spatial and temporal) and throughout a wide range of cost. NDVI data at a 250-meter square resolution (MODIS) is publically available and at reasonable cost. While other data networks and vegetation indices may be assessed within the course of the study, NDVI data acquired from the MODIS network will provide the predominant remotely sensed data to link to pasture production.

Figure 2: MODIS pixels (250 meter square): project "volunteer" ranch

Developing the "X to Y" relationship between the NDVI and pasture production requires the availability of both components of the relationship at the same resolution. MODIS provides an NDVI at 250-meter square resolution (see figure 2) but sampling pasture production at an equivalent resolution is impractical if not impossible. On the other hand, sampling of pasture production can occur practically at a one half-meter level. However, NDVI imagery at that resolution is not available and certainly not cost effectively.



MODIS grid provided to project by AFSC

A logical link can be formed between the one-half meter and 250-meter square resolutions by:

a) Using handheld radiometers calibrated to the MODIS satellite to attain NDVI resolution images at a one-half meter resolution;

b) Clipping pasture production from each of the one-half meter areas at which the handheld radiometer NDVI images are acquired to establish a direct one-to-one relationship between NDVI and pasture production; and

c) Acquiring sufficient NDVI observations at the one-half meter resolution within each MODIS pixel defined sample site in specific field locations that, when averaged, can be compared to the NDVI acquired for the same 250-meter square MODIS pixel.

If a successful "X to Y" relationship between the NDVI images and pasture production at the one-half meter level can be developed, AND a strong correlation is found between average NDVI images from handheld radiometer readings to the NDVI attained from the 250-meter square pixel in which the pasture clips are taken, THEN we can assume that the same "X to Y" relationship developed at the one-

half meter scale can be applied at the 250-meter square resolution AND that a 250-meter square MODIS image or average of a few can measure pasture at the field level.

Historical NDVI readings could be acquired at a 250-meter square MODIS resolution and, using the "X to Y" relationship with pasture production established in this study, could be used to define historical pasture production at the individual farm level and then used to set coverage for a pasture insurance program. We have lots of the historical "X" NDVI data points but no corresponding "Y" pasture production data points. A proven "X to Y" relationship from this study could provide the means to convert past NDVI data to pasture production for the purposes of developing an insurance program at the individual farm level. Similarly, the "X to Y" relationship can measure current year pasture production to alter or construct coverage for the future and assess production losses for insurance claims.

The key for this feasibility study to be successful is to demonstrate a higher level of accuracy (producers' perceptions) for the "X to Y" relationship to measure pasture production at the farm level than the two alternatives presently in practice which are:

a) an area-based remotely sensed program offered at a township level; or

b) a weather-index program based on precipitation measured at weather stations that may be up to 30 kilometers distant from the insured.