Agricultural Potential of the West Kootenay, B.C.

A regional review of the land, soil and climate for crop potential

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Photo: Earthy Organics Farm, Fruitvale, West Kootenay, 2010

Executive Summary

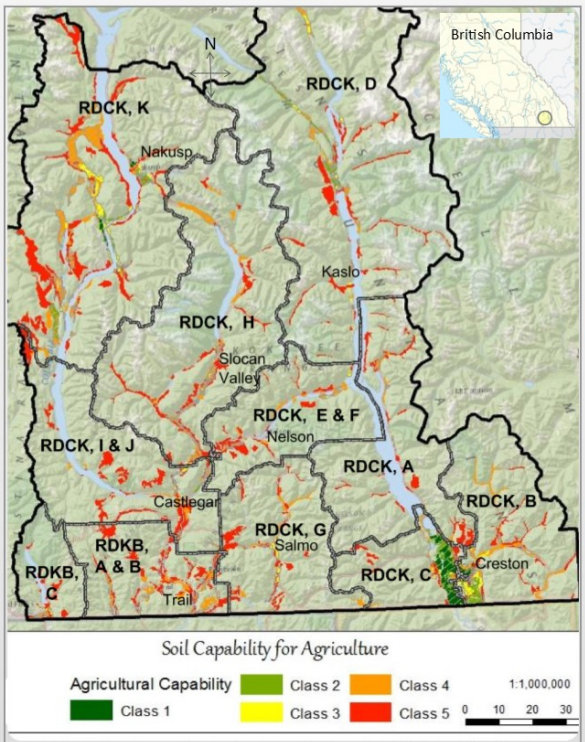
People often feel there is insufficient land and too short a growing season in the West Kootenay to support agriculture, but not only does the West Kootenay have enough agricultural land to be self-sufficient, it has a climate that is favourable and a frost-free growing season projected to increase by 30 to 90 days by 2050. An analysis of soils in the West Kootenay show that 86,000 hectares (ha) are suitable to grow fruit, vegetables and grains (Class 1 – 4 in the Canada Land Inventory's Soil Capability Classification for Agriculture) and another 113,000 ha in Class 5 that can support forage, animal pasture, orchards or specialty niche crops. The 2011 Canada Agricultural Census, however, shows only 20,000 ha is utilized for crops and pasture so 90% of suitable land is not used for agriculture.

The Agricultural Land Reserve (ALR) protects 66,000 ha of quality farmland and over 80% of the highest quality soils in the region (Class 1 -3), ensuring long-term food security with enough land to feed almost double the population.

Of the soils suitable for agriculture in the region, moisture retention is the main limitation to agricultural use, meaning that irrigation has the potential to increase productivity and a rise in temperatures will likely increase this requirement.

The region's mountainous topography leads to variability in land quality and climate with 91% of prime agricultural land concentrated in four regional district areas out of eleven and local microclimates that currently vary from 130 – 150 frost free days, which creates opportunities for pocket agriculture, specialty niche crops, and different production systems throughout the region.

Agricultural Potential of the West Kootenay

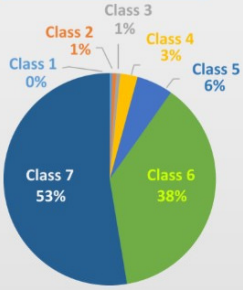


The West Kootenay includes the Regional District of Central Kootenay **(RDCK)** and Areas A, B and C in the Regional District of Kootenay Boundary **(RDKB).**

Farmland

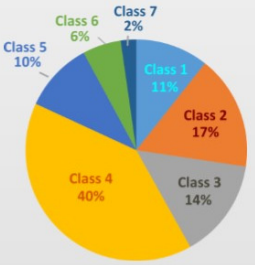
Soils capable of supporting agricultural crops in B.C. are given a Canada (B.C.) Land Inventory rating from Class 1 with no limitations to Class 7, not capable of supporting commercial agricultural crops. Class 5 may be considered marginal and can support forage but may be suited to specialty crops such as grapes.

Land in West Kootenay



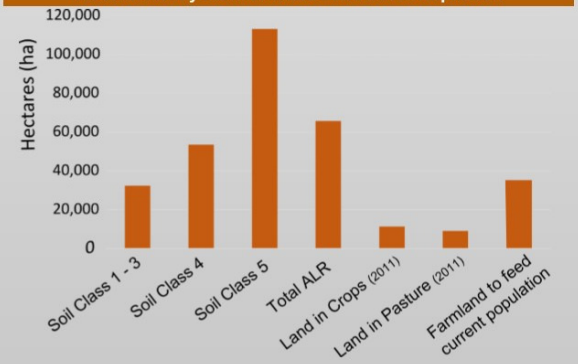
Class 1 -4 can support a range of crops and comprises 5% of total land. Class 5 is more marginal but may be suited to specialty crops (6%).

ALR in the West Kootenay



The Agricultural Land Reserve (ALR) protects 3.2% of land (66,000 ha) and is composed mostly of high quality soils (Class 1-4).

West Kootenay Farmland and Land Use Comparison



90% OF LAND THAT CAN SUPPORT CROPS OR PASTURE (CLASS 1-5) IS NOT USED FOR AGRICULTURE.

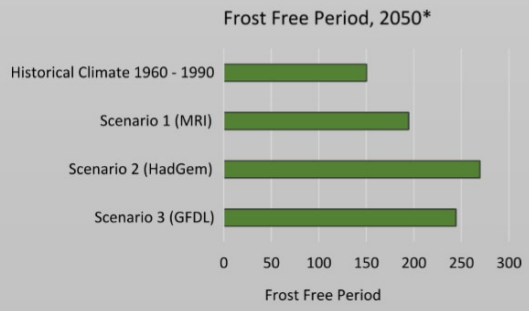
Only 10% of suitable land (31% of the ALR) is used for crops and pasture, excluding small scale, backyard food production.

Half a hectare can feed one person for one year (including meat and dairy) and there is enough land in the ALR to feed the current population of 70,000.

Climate Scenarios

Climate change projections for 2050 show a substantial increase in the Frost Free Period and Growing Degree Days which will likely extend the growing season by approximately 30 to 90 days and increase the range of crops that can be grown.

Global Climate Model scenarios show that comparatively, some areas will be warmer and drier and others cooler with more moisture.



**Based on averages for select agricultural areas under 800 meters.*

Information is drawn from an analysis of land and ALR with digitized Soil Capability data.
Study area: 2,035,785 ha (448,789 ha no data). ALR in the study area 65,737 ha (3,268 ha no data).
Reference: Roussin, Rachael, 2014. *Agricultural Potential of the West Kootenay. Contact: rachael.roussin@gmail.com*

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Objectives

The objective of this study is to determine the agricultural potential of the West Kootenay by identifying the total amount of agricultural land (Class 1 – 5) in the region and in the Agricultural Land Reserve (ALR), along with its capabilities and limitations for crop production, within the context of climate change. This information will be useful for new entrants to farming, food producers and distributors and regional planners to plan for future food production.

This study also addresses issues of agricultural land protection and food security by highlighting the scarceness of agricultural land in the West Kootenay and the value that it has for food resiliency and farming opportunities. This study does not address the economic viability or infrastructure required to develop agriculture in the region nor does it discuss meat, poultry, dairy or small scale food production at the backyard level. It is intended to provide an overall picture of the region's potential and bring attention to areas that may be better suited to specific crops than others. Maps that show the Soil Capability Classes 1 - 5 are included in this report and complement the information in this study.

Introduction

Food security and local agriculture are priority issues for citizens and local government in the West Kootenay. Three communities that participated in a 2009 Climate Change Adaptation Action Planning project choose food security as a priority issue area (Columbia Basin Trust, 2010), while a 2013 poll of residents showed that 75% of Kootenay residents prefer to buy food that is grown locally (Columbia Basin Rural Development Institute, 2013). Food security organizations are established in many communities and extensive research has been conducted on how to strengthen local food production and distribution (Steinman, 2010 and Regional District of Central Kootenay, 2011). Interest from new entrants to start farming is indicated by farmland access programs and regional agricultural education programs (North Kootenay Lake Community Services, 2013 and Young Agrarians, 2013).

Citizens' concerns about food security have emerged from an awareness of the region's reliance on imported food and an industrial food system as up to 95% of food consumed in the West Kootenay is not produced locally (Regional District of Central Kootenay, 2011). This reliance is vulnerable to a range of issues including climate change which poses a serious risk to global food production and food security (IPCC, 2014). For example, severe drought in the State of California that produces over half of all fruit and vegetables in the United States and the majority of imported produce to B.C., has resulted in decreased crops yields and an increase in the cost of produce across North America (Crawford, 2013 and CBC News, 2014).

In 2007, B.C. imported 95% of its fruits and nuts and 75% of its vegetables, of which 70% of vegetables came from the United States (20% from Mexico and 10% from China) and 60% of fruit from the United States (20% from China/Mexico/Chile and the remaining 20% from other nations) (B.C. Provincial Health Services Authority, 2010.). Common imported fruits and vegetables to B.C. include staples such as lettuce, oranges, berries and broccoli (Crawford, 2013 and CBC News, 2014), some of which can be produced in the B.C climate.

The West Kootenay has a strong history and culture of farming and self-sufficiency with many people growing food in their backyard gardens, hunting, fishing and gathering. European settlers had successes with large berry farms and orchards in the Slocan Valley and around Kootenay Lake (Lang, 2003 and Moir, 2011) and today small mixed farming operations exist throughout the region in areas with suitable land. Today Creston is the main commercial agricultural region growing primarily field crops and specializing in tree fruits and animal enterprises including beef and dairy. Thus, although the region is currently reliant on imported foods, the citizens of the West Kootenay have strong values associated with food security and a desire to believe that region could be self-sufficient if needed.

These values are reflected in the increased demand for locally produced food, of which there is often limited supply. The Kootenay Co-op in Nelson (population 10,000) sells over $2 million in produce annually of which many items they cannot source locally including celery, broccoli and some root vegetables that can be grown in the current climate. The short growing season also limits the variety of produce available before July first (Endless Harvest, Kootenay Co-op, Ferraro Foods, 2014). The Co-op communicates regularly with farmers in a collaborative approach to increase supply and informs them of items they would purchase more of locally. Last year the Co-op could have purchased each week an additional 1,000 – 1,500 lb of apples, 1,000lb of blueberries, 300 – 400 lb of broccoli and 400 – 600lb of melons. This indicates that there are market opportunities to increase local food production in the region.

The climate is current suitable for a range of crops and regional climate change studies project potential opportunities for agriculture with a longer growing season and more heat units to support a broader variety of fruits and vegetables but impacts such as an increase in weeds and pests, drier soils, less available water for irrigation and extreme climate events could have a negative impact for crop production (Adaptation Resource Kit, 2013).

Overall, the area being farmed in the entire Kootenay region decreased between 2001 and 2011 by 18.6% and the number of farms decreased by 9.4%. There was, however, a moderate increase in area farmed in parts of the West Kootenay, including Salmo, the Slocan Valley, Nelson and north of Kootenay Lake (Columbia Basin Rural Development Institute, 2013).

Pockets of mixed farming operations are successful in this mountainous region and produce a diverse range of crops. For example: Stellar Seeds Farm operates a vegetable seed business out of Johnson's Landing; Garden Hoe Farm in Wynndell specializes in multiple varieties of garlic; Earthy Organics in Fruitvale produces mixed vegetables and operates a Community Supported Agriculture Program; Meadow Brook Farm in Salmo operates a year-round salad greens business from a heated greenhouse; and Mad Dog Farm in Castlegar specializes in cucumbers from an unheated greenhouse (which once produced up to fifty varieties of potatoes). In addition to food production, three wineries in Creston and two in Trail are capitalizing on value-added wines from their grapes (Creston Valley Visitor Centre, 2014, Columbia Gardens, 2014 and SOAHC Estate Wines, 2014).

Land is a non-renewable resource and according to a study that assessed B.C.'s food self-sufficiency from a land based perspective and using primary production (farm gate production), half a hectare of farmland is needed to produce the food for one person for one year (including meat and dairy) given the production technology available today (B.C. Ministry of Agriculture and Lands, 2006). This equates to 35,000 ha for the current West Kootenay population of approximately 70,000 (see Appendix 1 for a complete summary of the study).

There is an awareness that agricultural land is limited in the West Kootenay but there has been little assessment on how much land actually exists, where it is and what the capabilities for crop production are. The Agricultural Land Reserve (ALR) that was established in 1973 to protect agricultural land in B.C. plays an important role to identify and protect some of the agricultural land in the region, however, not all land suitable for agriculture is included in the ALR and therefore does not fully recognize the agricultural potential of the region.

Although land suited for agriculture has several definitions, often of a local or international perspective, in B.C., the Land Capability for Agriculture Classification, as outlined by Runka (1973), is the most commonly cited reference. The Classification system is the basis for the provincial legislation that established the Agricultural Land Commission (Runka, 1977) and is the biophysical basis for defining the various categories of land for agriculture. The Classification has two categories, the *Capability Class*, which gives a rating in terms of increasing limitations for largely mechanized agriculture for a range of climatically suitable crops and a *Subclass* that identifies the limitation(s).

Class 1 has no, or very minor limitations and as the number of (or degree of) limitations increase, the Classification category and numerical value increases from 1 - 7. Generally, Classes 1 - 4 are considered as having good qualities for adapted crops, Class 5 and 6 are marginal and Class 7 is not suitable for crops or animal grazing. It is important to keep in mind that the Capability rating is for a range of crops. There are many crops that can thrive on what the Capability Class

would suggest is not suitable due to a range of limitations. For example, limitations such as soil water holding capacity, topography and stoniness might limit the cultivation of field crops, but it may be suitable for small plot mixed vegetables or niche crops such as grapes.

Recent changes to the ALR into Zone One and Zone Two have re-invigorated the discussion about the best means to protect agricultural land in the Province. The Kootenay region now falls under Zone 2 and thus lands once prioritized for agricultural activities are now given equal weight to economic, cultural and social values, regional planning objectives, and any "other prescribed considerations", opening up agricultural land for permitted non-farm uses (West Coast Environmental Law, 2014). These changes could have a cumulative impact to long-term farmland protection by allowing people to subdivide their properties and adding permitted non-farm uses in the ALR (West Coast Environmental Law, 2014).

This study therefore seeks to highlight the quality of land in the ALR and quantify the total amount of agricultural land in the West Kootenay to inform the region's capacity for food self-sufficiency and the opportunities for small scale agriculture.

Study Area: West Kootenay

The Kootenay region is comprised of the Kootenay Boundary, Central Kootenay and East Kootenay districts in the Southern Interior of British Columbia. The West Kootenay study area comprises all areas within the Regional District of Central Kootenay and areas A, B and C in the Regional District of Kootenay Boundary for a total of 2,484,574 hectares (ha) (Figure 1).

The entire Kootenay region has 392,557 ha in the ALR which is 8.4% of the province's total (Provincial Agricultural Land Commission Fact Sheet, 2014). Of the ALR in the Kootenay region, 17.5% is in the West Kootenay which accounts for 2.7% of the entire land base or 3.2% of this project's study area.

Agriculturally, the East Kootenay is associated with range land and a more arid climate and the Kootenay Boundary with range land in the south west and mixed agriculture around the City of Grand Forks.

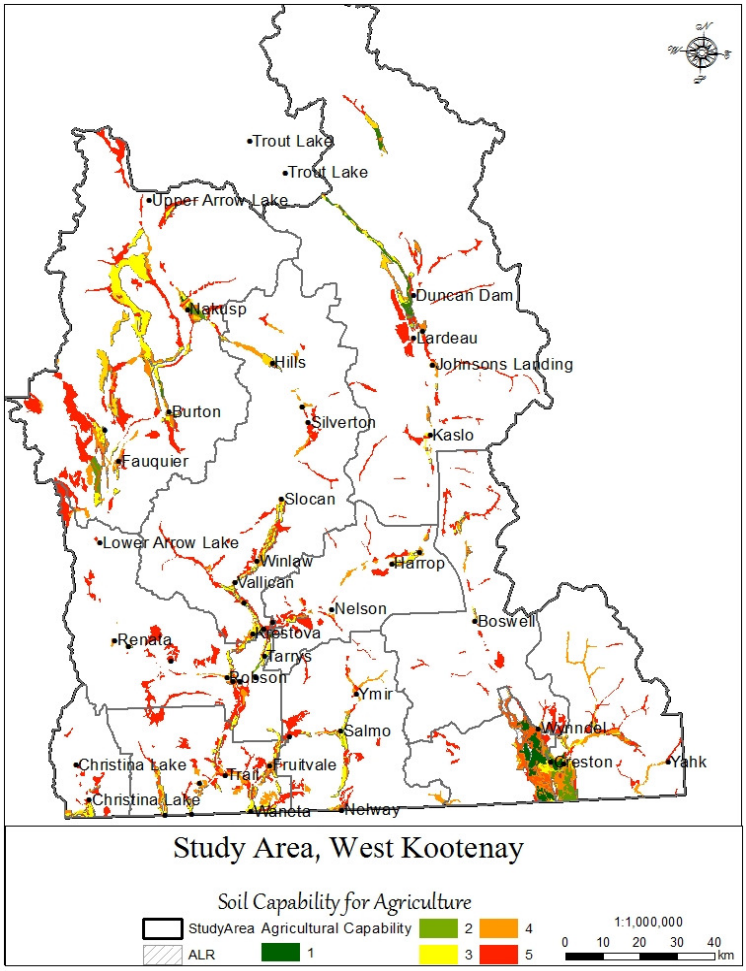
The mountainous landscape of the West Kootenay limits large scale agriculture, but pockets of arable land and a temperate climate permit the diverse production of field crops, annual vegetables, tree fruits, berries, poultry, beef and dairy. The area around Creston is the commercial agricultural centre of the region and crops are comprised mostly of tree fruits, forage and some grain. The Nakusp area (Central Kootenay Area K) has the most land in the ALR (Table 6) and produces the second highest amount of forage and alfalfa crops outside of the Creston area (Statistics Canada, 2011).

The study area includes the four cities of Trail, Rossland, Nelson and Castlegar and a number of towns and villages including Creston, Salmo, Nakusp and Kaslo and rural areas such as Burton, Lardeau and Ross Spur, which are home to approximately 70,000 West Kootenay residents. A network of highways, winding roads and mountain passes connect communities to each other and also to larger cities with Vancouver being 600 km to the West and Calgary 600 km to the East (Figure 1). The Census Consolidated Subdivision Areas distinguish the area boundaries within study area (Statistics Canada, 2011) (Table 1).

Digitized soil classification data were not available for the entire area within the geographic boundaries of the study area (Figure 2) or for all the ALR. Only areas with digitized data were used in the study with the exception of Class 4 or better soils that were updated to the digital files. Figure 2 shows the areas that are excluded from the study area.

- Total area in geographic boundary: 2,484,573 ha (448,789 ha has no digitized soil capability data).
    - Total study area: 2,035,785 ha
- Total ALR in geographic boundary: 69,006 ha (3,268 ha has no digitized soil capability data).
    - Total ALR study area 65,737 ha

Figure 1: Map of the Study area with Consolidated Census Regional District Boundaries and location within Southern B.C.



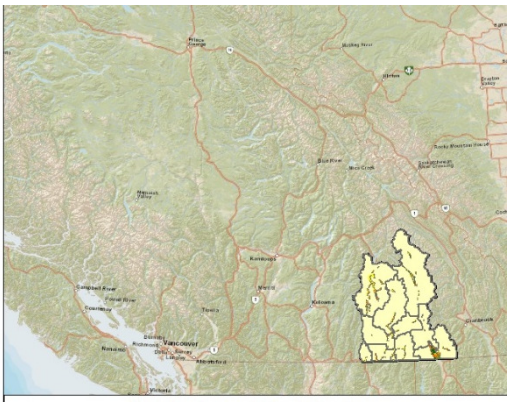
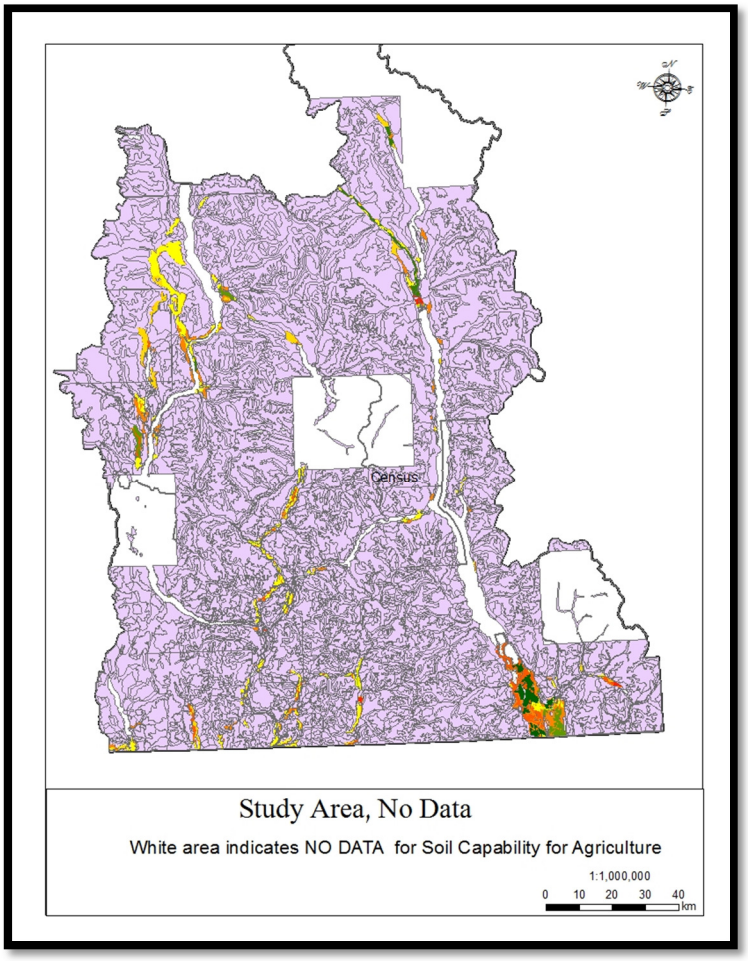


Table 1: Regional District Areas in the West Kootenay by Census Consolidated Subdivision Areas

Regional District Areas	**Associated Communities**
Central Kootenay A	Kootenay Lake E. Shore, Crawford Bay and Wynndel
Central Kootenay B	Creston East, Erickson, Canyon and Yhak
Central Kootenay C	Creston South and West
Central Kootenay D	N. Kootenay Lake, Kaslo, Lardeau, Argenta, Meadow Creek, Trout Lake
Central Kootenay E & F	Nelson, West Arm, Harrop and Proctor
Central Kootenay G	Salmo, Ymir, Ross Spur
Central Kootenay H	Slocan Valley, South Slocan, Passmore, Krestova, Silverton, New Denver, Hills
Central Kootenay J & I	Castlegar, Deer Park, Thrums, Tarrys
Central Kootenay K	Nakusp, Burton, Fauquier, Whatchan Lake
Kootenay Boundary A & B	Trail, Rossland, Warfield, Montrose, Fruitvale, Big Sheep Creek
Kootenay Boundary C	Christina Lake

Figure 2: Areas in the Study Area with no digitized Soil Capability for Agriculture data



Agricultural Land in the West Kootenay

In the Soil Capability for Agriculture Classification system, lands are grouped into seven classes according to their potential and limitations to agricultural use depending on inherent soils and climate characteristics with Class 1 having no limitations to mechanized field crop production and Class 7 having no capability for crop production (Runka, 1973). Climatic characteristics that affect crop production determine the highest potential agricultural capability of a soil. For example, Class 1 soils must be located in an area which has at least a Class 1 climate capability for agriculture rating (Jungen, 1980).

Although the usual definition of Soil Capability for Agriculture (Runka, 1973) includes only Classes 1-4, this study extended the definition in some cases to Classes 5 and even 6, in consideration of specialty or niche crops.

Important factors on which the soil capability for agriculture classification is based:

- **The productivity of any specified crop, distance to market, available transportation, hazards of crop damage due to storms or economic viability is NOT considered in the Land Classification.**

- **In areas which are climatically suitable for growing tree fruits and grapes, a Class 5 level stoniness or topography limitation may not be a significant limitation to these crops** (B.C. Ministry of Agriculture and Foods, Ministry of Environment, 1983)

Further information on Soil Capability Classification can be found on the website for the Provincial Agriculture Land Commission (http://www.alc.gov.bc.ca/publications/).

The most suitable soils for agriculture in the study area are located on fluvial and lacustrine deposits (river and lake deposits, respectfully). These areas are located around the Kootenay River floodplain, the area south of Creston, the Salmo and Slocan River valleys and the stone-free terraces along the Columbia River. Moderate limitations may include poor soil drainage on the floodplain, poor soil structure in the lacustrine areas and low moisture holding capacity on the sandy terraces (Jungen, 1980). These soils are mostly classified as Class 1 – 2.

Other areas suitable for arable agriculture include some glaciofluvial terraces, fluvial fans and glacial till deposits. Limitations for these soils include adverse topography, low soil moisture holding capacity, stoniness and a short frost-free period. These soils are classified as 3 - 4. Class 4 soils may have more severe limitations than Class 3 soils (Jungen, 1980).

Class 5 soils are dispersed through the region on moderately sloping glacial till, coarse textured fans, stony glaciofluvial terraces and some areas that are susceptible to flooding. Soils in this class have severe limitations that include stoniness, topography, low water holding capacity and excess water (Jungen, 1980). The limitations in this class may restrict their capability to produce perennial forage but improvement practices are feasible (Canada Land Inventory, 1972).

Climate

Precipitation and growing conditions vary throughout the area due to the mountainous topography and bodies of water. Temperature is more consistent than precipitation but micro-climates such as rain shadows and frost pockets exist throughout the region. Long-term records from the Atmospheric Environmental Service used for the Climate Capability for Agriculture ratings (Climatology Unit, 1981) show a range in the frost free period for the region from 130 – 149 days. There is even greater variability in precipitation with historic Climate Moisture Deficits ranging from -180 mm in Kaslo to almost -400 mm in Columbia Gardens near Trail (see Appendix 2 for a complete overview of Climate Capability for Agriculture ratings).

Methods

This study employed Geographic Information Systems (GIS) to analyse the Soil Capability for Agriculture Classifications to estimate how much agricultural land exists in the study area. Global Climate Models (GCM) provide projections for a range of possible climate scenarios for the year 2050. The ALR is used as an indication of how much land is available for agriculture, while land in crops and pasture by Regional District area from the 2011 Agricultural Census provides an idea of how much agricultural land is currently in use.

This report was informed by:

- a literature review of agriculture and climate change resources in B.C.,
- interviews with local food distributors and producers, and
- Statistics Canada 2011 Agricultural Census for the region.

GIS mapping and Soil Capability for Agriculture

The quantity of land that has the potential for agriculture is based on the Soil Capability for Agriculture Classifications developed by the Canada Land Inventory (Canada Land Inventory, 1972 and Runka, 1973).

Data sources included all published soil and land capability information including the 1:125,000 Soil Capability for Agriculture Maps (Canada Land Inventory Maps, 1972) and the 1:50,000 agricultural capability GIS data (B.C. Ministry of Environment, 2013). The boundaries of the ALR were based on GIS files from B.C. Data Distribution Services (B.C. Data Distribution Services, 2014).

This information was transformed through GIS for analyses using intersect tools and used only the unimproved soil Capability Class ratings. Unimproved ratings are based on the conditions that exist at the time of the survey, without irrigation. Potential improvements include: drainage, irrigation, diking, stone removal, salinity alleviation, sub soiling, and the addition of fertilizer or nutrients.

A single Capability Class was determined for each parcel of land (polygon) when two or more Capability Classes were present (complex polygons). This was done by calculating a weighted average using the percentages of each of the various ratings in each polygon. The rationale for this methodology was to give polygons one classification for the quantitative assessment so that land classes have a single classification for each parcel. This also improved the visibility of classifications on the maps of the region (last chapter). The disadvantage is that some small pockets of high and low classes are not individually represented.

Capability Classes are rounded to a single classification in the following manner:

- 1 = 1 to 1.9
- 2 =2 to 2.9
- 3 = 3 to 3.9
- 4 = 4 to 4.9
- 5 = 5 to 5.9
- 6 = 6 to 6.9
- 7 = 7

See Appendix 3 for more details on data analysis for land classification.

Capability Subclass (limitations)

The “capability subclass” indicates varying intensities of limitations and hazards and provides information on the kinds of management problems or limitations for mineral soils.

*Table 2: Capability Subclass (limitations) for Mineral Soils***

Capability Subclass	
C	Climate: adverse climate
D	Undesirable soil structure and/or low perviousness
E	Erosion: erosion damage
F	Fertility: low fertility, low cation exchange capacity or nutrient holding ability
I	Inundation: inundation by streams or lakes
M	Moisture: low moisture holding capacity
N	Salinity: soluble salt in the soil reduces crop growth
P*	Stoniness: coarse fragments significantly hinder tillage and planting
R	Depth to solid bedrock: bedrock near the surface restricts rooting depth
T*	Topography: steepness hinders the use of farm machinery and decreases uniformity of growth and maturity of crops
W	Excess water
X	Cumulative minor adverse characteristics

**Areas which are climatically suitable for growing tree fruits and grapes, a Class 5 level stoniness or topography limitation may not be a significant limitation to these crops (Ministry of Environment and Soils, 1982, Land Capability Classification for Agriculture in British Columbia).*

*** Very little organic soils are in the Study Area. Organic soils symbol is O.*

Climate change projections

Global Climate Models (GCM) were used from the International Panel on Climate Change's (IPCC) Fifth Assessment Report to project future climate scenarios for 2050. Climate models have been downscaled for the Pacific Northwest and British Columbia with the ClimateBC program designed by the UBC Faculty of Forestry, which utilizes historical weather station data, global circulation models and regional predictions to project future seasonal and annual climate variables (UBC Faculty of Forestry, 2014). The program calculates seasonal and annual climate variables for specific locations based on latitude, longitude and elevation.

Experts, including Greg Utzig, M.Sc., P.Ag, a conservation ecologist and land use planning consultant based in Nelson, B.C., were consulted to select the appropriate climate models. Three models were chosen that represent the broad range of projected climate scenarios for 2050 with the 'business as usual' scenario meaning no change in global CO_2 emissions (Table 3).

Table 3: Global Climate Models from the IPCC's Fifth Assessment Report

Global Climate Model	**Characteristics**
HadGem	hot/dry
GFDL	very hot/wet
MRI	warm/moist

Seven climate study areas were selected for analysis based on the presence of soil capability ratings of 4 or better with some known agricultural activity (Figure 3). Multiple data points in GIS were taken in a one km grid for all Class 1 - 5 lands under 800 meters elevation for each climate study area. The data were then averaged for each area. Four areas were chosen for geographic representativeness of the region and three areas were selected that had known agricultural activity and accessibility to transportation corridors (see below).

Illustrative examples that provide a range of climate conditions and geographic representativeness (elevations are an average for all geographic points in each area):

- North West: Nakusp (incl. Burton and lake shore), Central Kootenay Area K, 558 m
- North East: Kaslo/Lardeau/Argenta, Central Kootenay Area D, 628 m
- South East: Creston, Central Kootenay Areas B and C, 590 m
- South West: Trail & Columbia Gardens, Kootenay Boundary Area B, 515 m

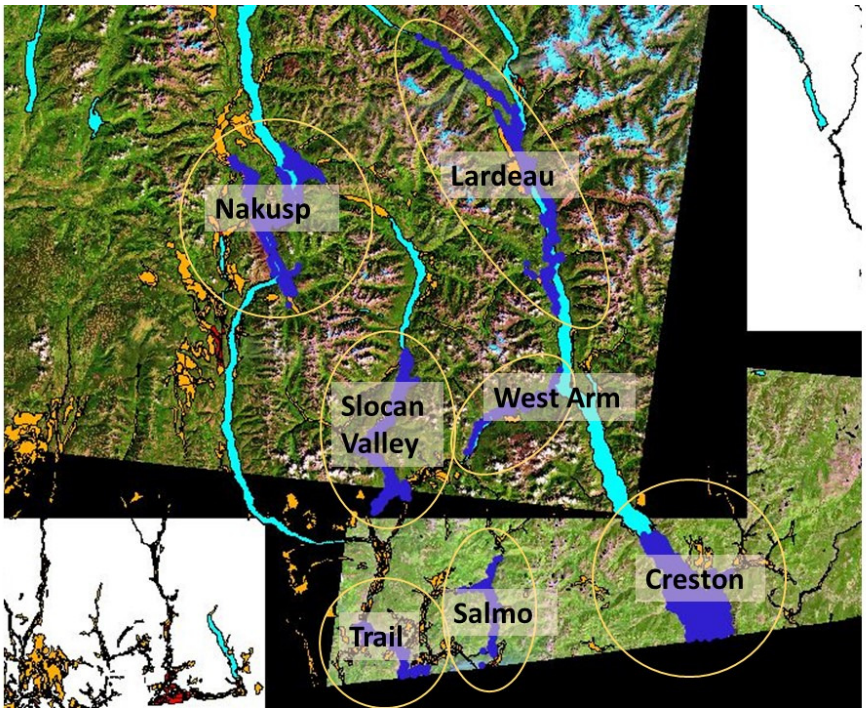
Areas with agricultural activity near transportation corridors were also selected for the climate analysis:

- Slocan Valley, Central Kootenay Area H, 592 m
- Salmo, Central Kootenay Area G, 713 m
- West Arm (Harrop, Proctor), Central Kootenay Area E, 597 m

In some instances, all areas were combined to analyse the region as a whole.

Figure 3: Map of Climate Study Areas

The colour dark blue indicates the geographic area included in each climate study area.



Present status of agriculture

The 2011 Canada Agricultural Census was used to understand land currently utilized for crops and the diversity of crops being grown in the study area. The category “Hectares in Crops” was used as the main category to quantify how much land is currently under cultivation for field crops, fruit, vegetable, berry and nut production. This category does not include Christmas trees, nursery products, sod, mushrooms, summer fallow land, herbs or garlic. Summer fallow land was negligible with 94 hectares of total summer fallow land for the study area.

The category “Farms Reporting” was also used to show the range of crops being grown as the census data does not always report hectares under production for confidentiality purposes and because many small farms have less than a hectare under production of one specific crop.

Natural or seeded pasture is used as an indication of agricultural land use but this study does not address agricultural capability or suitability for animal grazing or the cultivation of fodder crops.

Suitability for crops

The Soil Capability for Agriculture ratings include soil chemical characteristics, but this study focuses predominantly on the soil physical properties. Climate suitability is based on the historic climate of the region and Global Climate Model projections for 2050.

Suggestions on suitability crops for the region are based on growing guides and feasibility studies for crop production in other areas of Canada and the United States (Otto, 1993, Garland, 1991, University of Wisconsin, 1992).

Demand for local produce

Three interviews with local producers and three interviews with produce distributors were used as a qualitative indicator of the current state of supply and demand for local produce.

Limitations

Land availability for agriculture

This study does not include current land use data that could inform how much land (Class 1 – 5) is *actually* available for agricultural purposes. For example, land that is not in the ALR, may be transformed in ways that can no longer be used for agriculture (ie: industry or housing).

This study also does not identify land in the ALR currently used for agriculture which means that this study cannot quantify the amount of unused ALR.

Current status of agriculture and/or food production

The current status of agriculture is dependent on the 2011 Statistics Canada Agricultural Census which accounts only for farms that report to Census Canada and does not account for small scale or backyard food production.

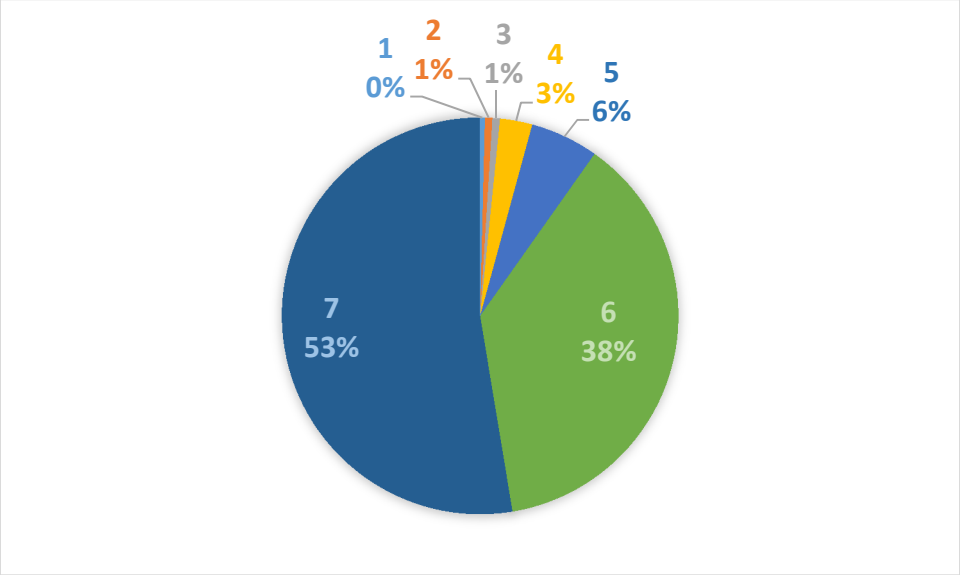
Climate change impacts to agriculture

This study focuses on the opportunities that increased temperatures will have to crop production in the region and does not explore other impacts such as extreme weather, precipitation variability and water supply.

Results

Class 1 – 4 soils that can support a range of crops comprise 5% of the total study area while Class 5 soils that support forage, animal pasture or specialty crops comprise 6%, meaning that 11% of the total study area has some agricultural capability for a total of 199,000 ha (Figure 4). Although agricultural land is limited in the region, in most areas it is underutilized and does have potential for increased agricultural activity. Of land suitable for agriculture (Class 1 – 5), only 10% is under production for crops and pasture or 31% of the ALR (Table 6).

Figure 4: Total land in the study area by Soil Capability Classes 1 – 7.



Percentages are rounded to the nearest decimal place. For this reason total percentages equal 102%.

The ALR provides a good indication of land zoned for agriculture and comprises 3.2% of the total study area. The majority of the ALR is high quality with 42% of the ALR being prime agricultural land (Class 1 - 3), 40% being Class 4 and 10% as Class 5 (Figure 5). Class 6 and 7 comprises less than 8% of the ALR and has little to no capability for agriculture. This compares with the Regional District of East Kootenay where 70% of the ALR is Class 5 and 6 (Regional District of East Kootenay, 2013).

The ALR protects the majority of the limited Class 1 – 3 prime agricultural land, half of the Class 4, 6% of Class 5 and a negligible amount of the Class 6 and 7 lands (Table 4). The reason why lower capability classes were originally included in the ALR is if historical land use patterns indicated that the land could be used for agriculture in conjunction with Class 1 to 4 and where small pockets non-agricultural land might have allowed incompatible land uses into the agricultural community (Runka, 1977).

Figure 5: Land in the Agricultural Land Reserve in the study area by Soil Capability Classes 1 – 7.

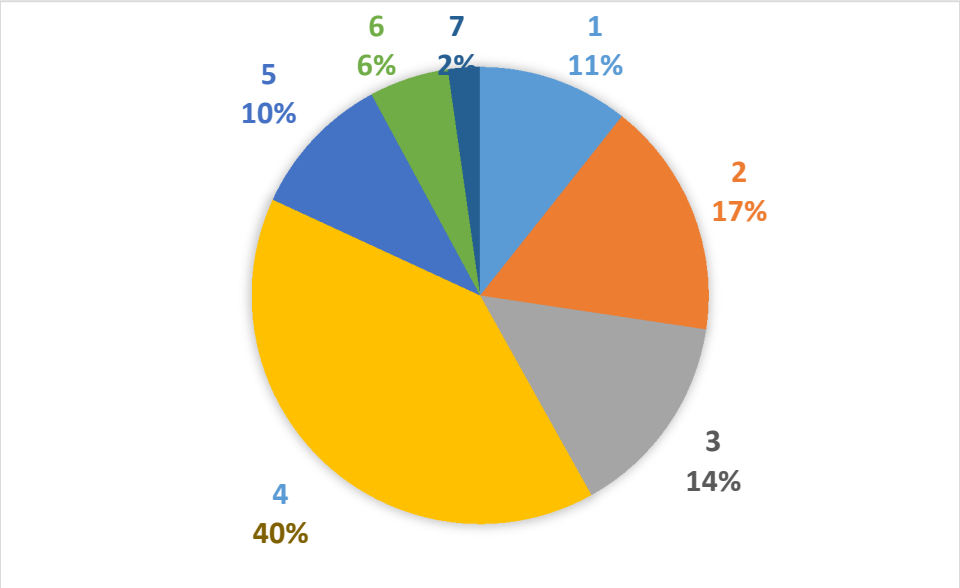
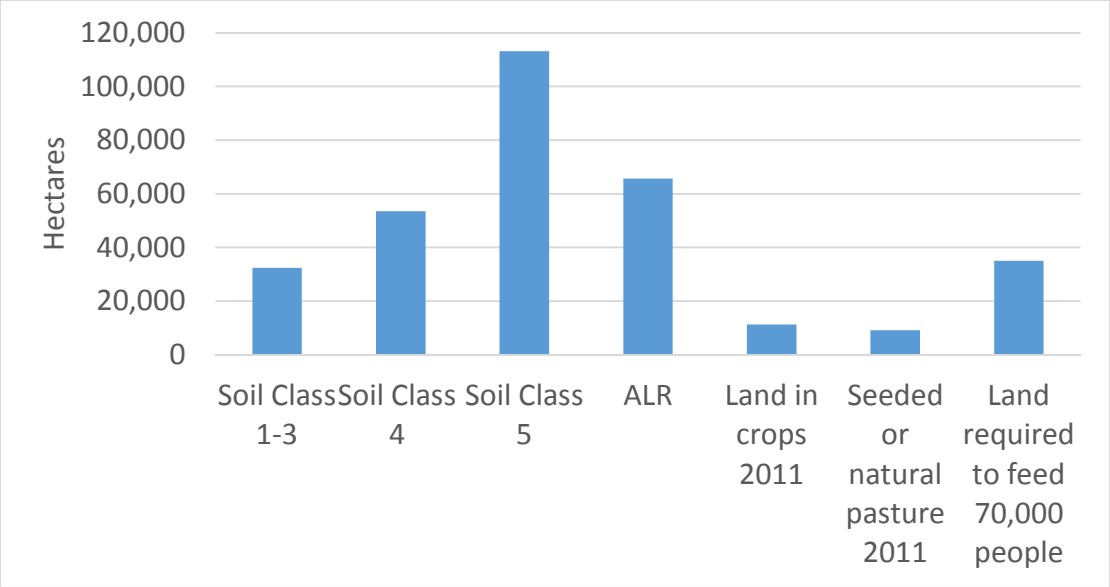


Table 4: Total hectares of Soil Capability Classifications 1 – 7 in the study area and % in the ALR.

Soil Capability – Study Area			Soil Capability – **ALR** in Study Area		
Capability Class	**Area (ha)**	**% of Study Area**	**Capability Class - ALR**	**Area (ha)**	**% of Capability Class**
1	7,737	0.4 %	1	7,000	90.5 %
2	12,336	0.6 %	2	10,994	89.1 %
3	12,572	0.6 %	3	9,551	76.0 %
4	53,520	2.6 %	4	26,279	49.1 %
5	113,168	5.6 %	5	6,724	5.9 %
6	765,371	37.6 %	6	3,699	0.5 %
7	1,071,077	52.6 %	7	1,488	0.1 %
Total Ha in study area	**2,035,785**	100 %	**Total ALR study area**	**65,737**	**3.2 % of study area**

Half a hectare of land is required to produce food for one person for one year in B.C. (B.C. Ministry of Agriculture and Lands, 2006); therefore, 35,000 ha are required for the West Kootenay's current population of 70,000. In the West Kootenay, there is not sufficient Class 1 - 3 land to provide for 70,000 people (Figure 6). However, if Class 4 is included, that brings the total area of agricultural land up to 86,000 ha and including Class 5 the total would be 199,000 ha. The ALR includes almost double the required amount of land required to feed the current population with 66,000 ha.

Figure 6: Land inventory and land use comparison of the study area.



Moisture holding capacity is the primary limitation for soils in the ALR with 34.7% of total limitations. Irrigation can improve this limitation for agricultural use (Table 5).

Topography is the second most limiting factor to soils in the ALR with 22% of the soils having this limitation and this limitation cannot be simply overcome. Excess water and stoniness are the third primary limitations with 11.2% and 10.8% respectively. Stoniness is hard to overcome but may not be a significant limitation to crops that do not require mechanized machinery. See Appendix 6 for a table of secondary subclass limitations.

It is important to highlight that a Class 5 level of stoniness or topography may not be a significant limitation to the cultivation of tree fruits or grapes where the climate is suitable (Canada Land Inventory, 1972) and therefore soils with these respective limitations may have more agricultural potential with climate change.

Table 5: Primary limitations for agriculture in the ALR in the study area.

Limitation		**Area (ha)**	**% ALR**
<Null>		5,118.3	7.8
C	Climate	2,860.1	4.4
D	Undesirable soil structure	3,921.9	6.0
E	Erosion damage	0.2	0.0
I	Inundation by streams or lakes	1,004.3	1.5
M	Moisture holding capacity	22,842.8	34.7
P	Stoniness	7,090.7	10.8
R	Depth to solid bedrock	360.3	0.5
T	Topography	14,468.5	22.0
W	Excess water	7,381.7	11.2
X	Cumulative minor adverse characteristics	689.1	1.0
Study area (ALR)		65,737.8	100%

The majority of the ALR in the study area (54%) has private ownership status. Crown Federal, Provincial and Municipal ownership comprises 24% and 22% of the ALR with “no status”. “No status” likely means Crown Land that has not yet been designated for land use purposes.

Land distribution by Regional District Electoral Areas

Regional District of Central Kootenay (RDCK) Areas B, C and K have the highest amounts of Class 1 - 3 land and the most hectares in the ALR. These areas also have the most hectares used for crops or pasture demonstrating that agricultural land is currently being used in these areas (Table 6). Area D, in the North Eastern portion of the study area, has the fourth largest amount of Class 1 - 3 land and ALR but a minimal amount of land under agricultural production with only 4% of the ALR in this area being used for crops or pasture (See Appendix 4 for detailed breakdown of Class 1 - 7 land by area and % in the ALR).

Localities with the highest amount of prime agricultural land (Class 1 – 3) include the RDCK Electoral Areas B, C, D, and K with over 5,000 hectares which comprise 91% of the total Class 1- 3 land (Figure 7 and Table 6):

- Creston area (Central Kootenay B &C): 46%
- Nakusp area (Central Kootenay K): 29%
- Lardeau area (Central Kootenay D): 16%

All Regional District Areas have between 3,000 and 19,000 ha of Class 4 - 5 land except Area K (North West portion of the study area) that has 50,668 ha of Class 4 and 5 land. Area K also has the most ALR in the region (Table 6). Many Regional District Areas have underutilized agricultural land such as Central Kootenay Area G (Salmo) which has 2,431 ha in the ALR and only 36% used for crops and pasture (Table 6).

The agricultural area of the Slocan Valley (Central Kootenay Area H) has almost exclusively Class 4 and 5 soils with the most farms reporting vegetable production (Figure 13) which indicates that Class 4 and 5 soils have a broad range of capabilities if managed accordingly. Earthy Organics Farm in Fruitvale operates a mixed vegetable farm on Class 4 and 5 soils and has overcome the limitations of stoniness and low moisture holding capacity by removing large fragments and using crop rotations with green cover crops to increase organic matter.

See the last chapter in this report for Soil Capability for Agriculture maps by Regional District Area that show the geographic locations of all Class 1 - 5 land.

Figure 7: Soil Capability Classes by Regional District Area

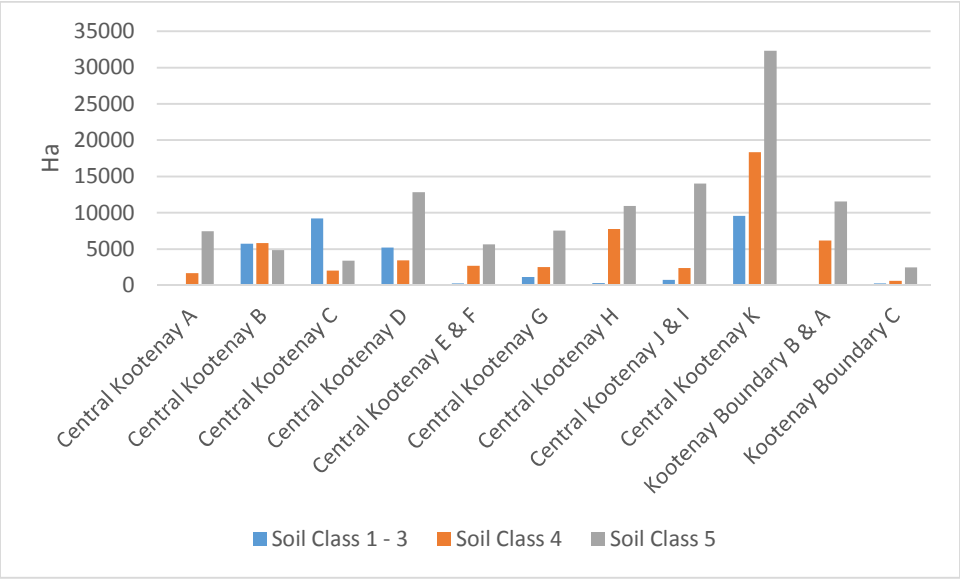


Table 6: Overview of soil capability by Regional District Electoral Area, ALR and land in use for agriculture. All areas reported in hectares.

Regional District Electoral Area	Soil Class 1-3	Soil Class 4	Soil Class 5	Total ALR	Land in crops 2011*	Seeded or natural pasture 2011	Land used for agriculture as % of ALR
Central Kootenay A	124	1,667	7,471	492	68	150	44%
Central Kootenay B	5,763	5,826	4,879	7,375	4,560	558	69%
Central Kootenay C	9,235	2,021	3,416	12,110	4,352	3,506	65%
Central Kootenay D	5,205	3,450	12,849	7,295	177	82	4%
Central Kootenay E & F	271	2,722	5,650	1,124	299	78	34%
Central Kootenay G	1,139	2,505	7,552	2,431	189	693	36%
Central Kootenay H	329	7,751	10,936	4,427	325	932	28%
Central Kootenay J & I	750	2,411	14,044	1,852	112	464	31%
Central Kootenay K	9,559	18,348	32,318	22,804	959	1,924	13%
Kootenay Boundary B & A	0.0	6,178	11,556	4,667	277	725	21%
Kootenay Boundary C	267	636	2,492	1,156	**	**	**
Total	**32,379**	**53,520**	**113,168**	**65,737**	**11,318**	**9,112**	**31%**

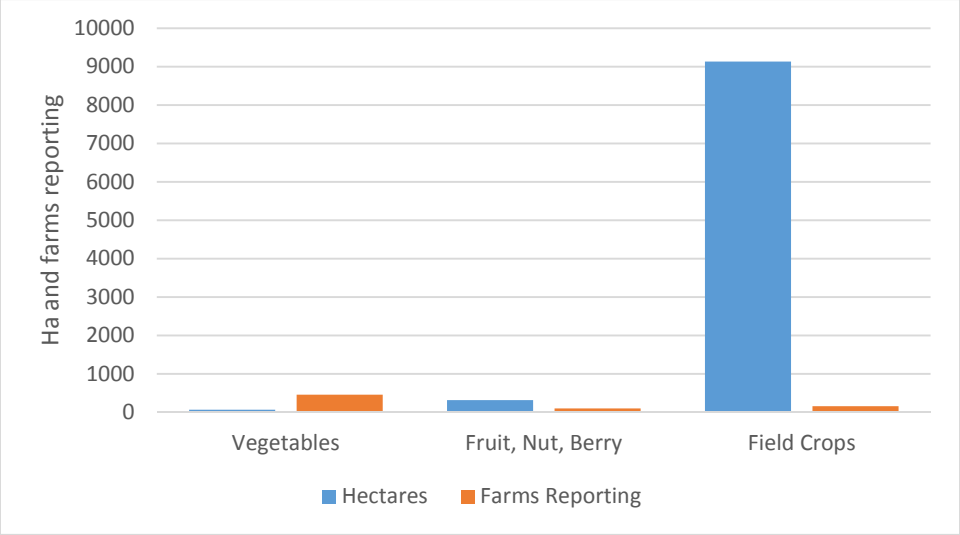
*Land in crops does not account for summer fallow land, herbs (including garlic) or Christmas trees
** Agricultural data amalgamated with Kootenay Boundary B

Present status of agriculture (crops)

The majority of crops cultivated in the region fall under the category of field crops, which includes wheat, barley, sweet corn, corn for silage, potatoes and non-edible forage (for humans) such as alfalfa. Alfalfa mixes and tame hay and fodder crops comprise the majority of all field crops in the region (Figure 8). Creston has the most hectares in field crops with 7,187 ha and 215 farms reporting while Nakusp has 943 ha and 50 farms reporting and the rest of the region combined has 1,006 ha with 128 farms reporting indicating that the majority of larger scale commercial field crop production is in the Creston area (Figure 10).

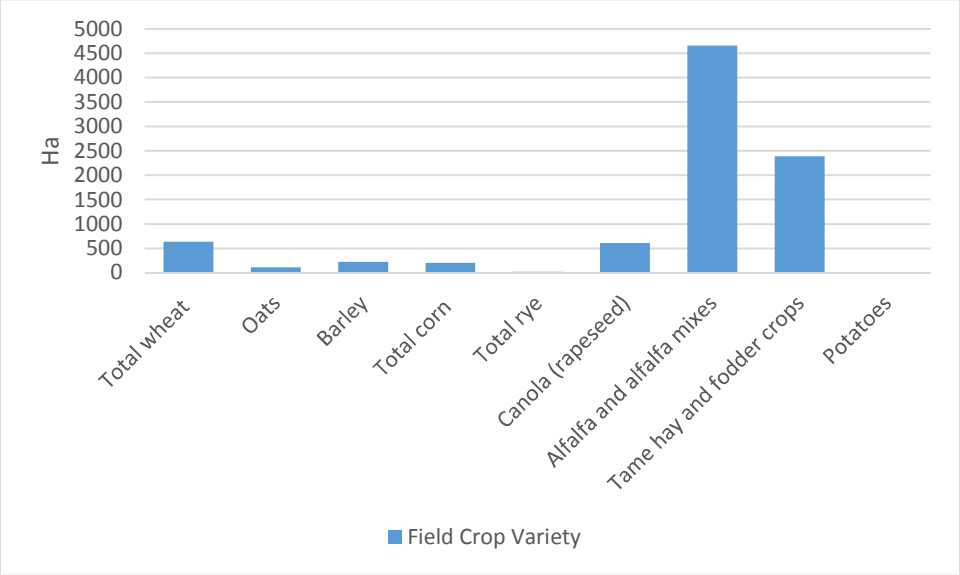
2010 gross farm receipts also indicate that the scale of agricultural activity in the study area is mostly small scale outside of the Creston area (Figure 11).

Figure 8: Land in crops by category (excluding pasture), 2011 census year.



**Crops include tree fruit, nuts, mixed vegetables and field crops. Does not include greenhouse vegetables, seeded pasture, herbs (including garlic) or Christmas trees.*

Figure 9: Area of field crops by variety for study area, 2011 census year.*



**Field crop varieties reported in Creston: spring wheat, winter wheat, oats, tame hay and fodder crops, alfalfa, canola, fall rye, barley, corn for silage, potatoes*

**Field crop varieties reported outside of the Creston area: alfalfa, tame hay and fodder crops, potatoes*

Figure 10: Total land in crops (all crop categories excluding pasture) by Regional District Area, 2011 census year.

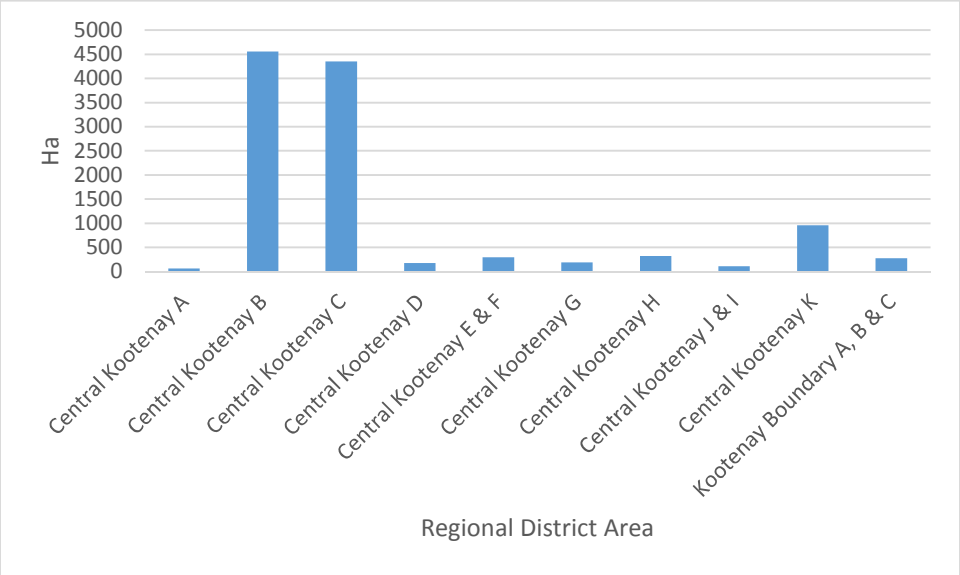
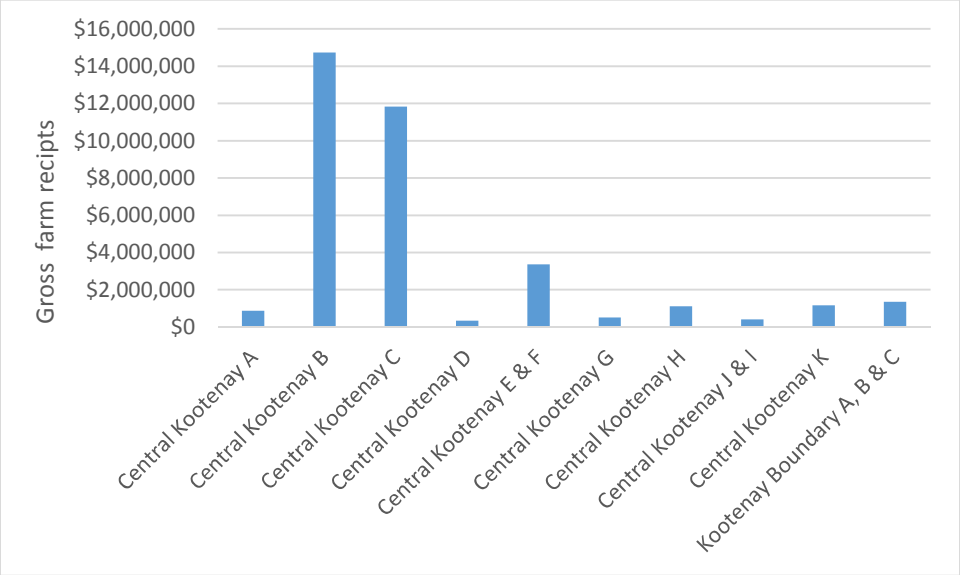


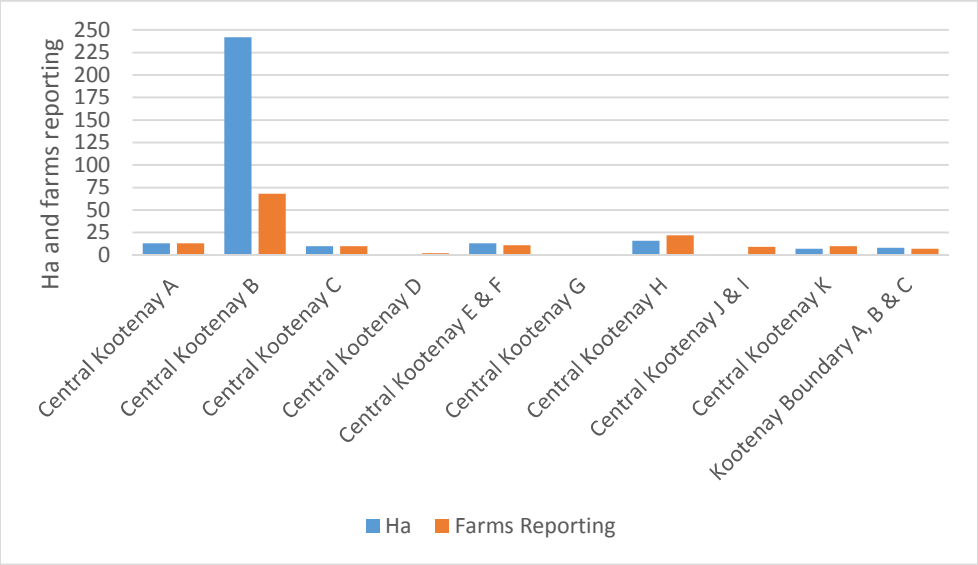
Figure 11: Total gross farm receipts by Regional District Area, 2011 census year.



A total of 310 hectares of tree fruits are reported for the region. The varieties reported include cherries, plums, apricots, peaches, pears, grapes and apples (Figure 12). Creston reports the most hectares of tree fruits with the dominant crop as cherries.

Large scale berry production is minimal in the region with only 9 hectares under cultivation for blueberries, strawberries and raspberries; however, 54 farms report growing strawberries, 72 farms report growing raspberries and 38 farms report growing blueberries. This indicates that although the region is capable of berry cultivation, large scale production is not embraced by the farm industry.

Figure 12: Total tree fruits, nuts and berries by Regional District Area, 2011 census year.



A broad diversity of annual vegetables are grown throughout the region for a total of 65 ha (Figure 13). Unlike field crops, the amount of farms reporting mixed vegetables surpasses the total hectares under production with 99 farms reporting which is an indication of many small-lot farm operations (Statistics Canada data can publish crop varieties reported by farms without specifying hectares). For example, area H which includes the Slocan Valley, has more farms reporting crop production than hectares under production indicating that many small farms are producing a wide range of crops on less than one hectare (Figure 13). Table 7 shows the diversity of annual vegetable crops that can be grown in the region. It should be emphasized that this study does not include small scale food production, such as the backyard garden, so the varieties reported are limited to the Statistics Canada categories and farms that submit data to Statistic Canada.

See Appendix 7 for graphs of total farms reporting all vegetable crop varieties

Figure 13: Total mixed vegetable production in the study area, 2011

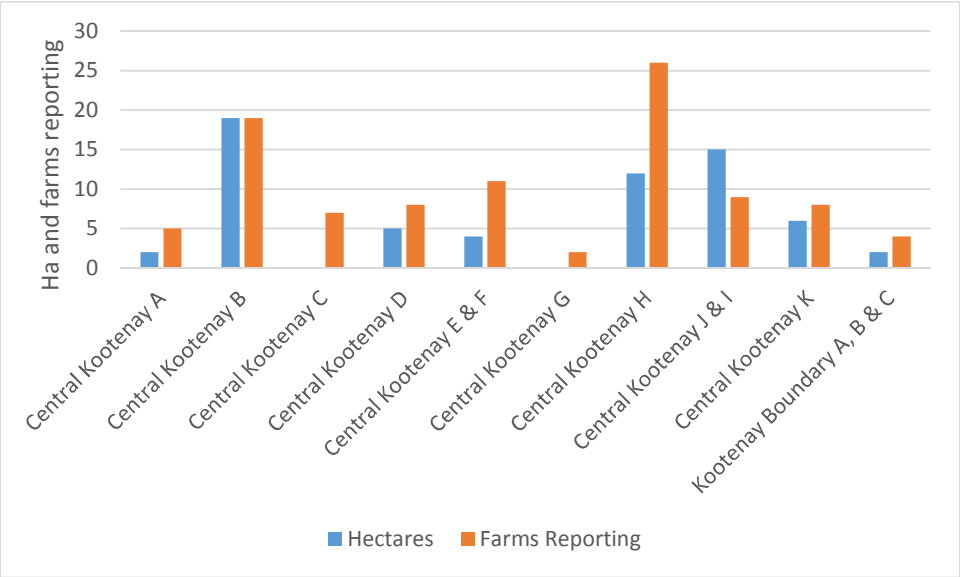


Table 7: Tree fruit, vegetable and berry varieties reported by farms in the study area.

Fruit/Veg group	**Variety**
Veg – Cool/hardy	Green peas, onions, lettuce, spinach, asparagus
Veg - Root	Carrots, beets and radishes, turnips and rutabagas
Veg - Brassica	Cabbage, Chinese cabbage, cauliflower and broccoli
Veg – Warm/tender	Tomatoes, squash and zucchini, peppers, pumpkins, sweet corn, cucumbers, green and wax beans
Fruit	Cherry, apple, pear, peach, plums, apricots, grapes
Berries	Strawberries, raspberries, blueberries

Although the soils in the region are suitable for a wide range of crops including those with topography and stoniness limitations, the climate has historically limited the cultivation of some perennial and annual crops in the region that require mild winters, a minimum amount of Growing Degree Days (GDD) and a long Frost-Free Period (FFP). Tree fruits as well as grapes can be especially sensitive to low winter temperatures. Apples are the most hardy tree fruit and can survive winter minimum temperatures of around - 35 ^{0}C for some varieties.

Grapes are a good example of a perennial plant that is commonly limited by climate in B.C. A minimum of 850 grape GDD above 10^{o}C are needed to mature very early wine grape varieties currently produced in B.C. and more than 1400 are needed to mature late wine grape selections (Vielvoye, 2008). GDD above 10^{o}C based on a 22 year historical average for Creston is 1084 GGD and Nakusp is 975 GDD (Farm West, 2014).

Hops are an example of a value added perennial crop that is suited to the climate and soils of the West Kootenay. Hops require long daylight hours, well-draining soil, abundant moisture and a minimum of 120 day FFP. Long day lengths (15 hours or more) are also needed so hop production is limited to the latitudes between 35 and 55 degrees to fulfil the day length requirements (Alberta Agriculture, Food and Rural Development, 2005).

Raspberries are currently suited to most climates in the region and do well in well-drained soils, which comprise the majority of the agricultural soils in the region.

Melons typify tender annual crops that are currently limited by climate in many areas of the West Kootenay. Melons, including watermelons, grow best in air temperatures ranging from 21 – 32°C and where nighttime temperatures are above 10°C. Watermelons require 65 to 90 frost-free days to reach harvest and do not tolerate frost (Albert, 2009). Unlike some perennial crops, annual crops like melons require finer soils that are rich with organic matter and nutrients.

Quinoa is a crop suited to higher elevation areas which has been tested extensively in places like Colorado in the United States at elevations of 2,000 m – 3,000 m and is grown mainly in mountainous regions because it requires cool evenings and air temperatures below 32 - 35°C. Quinoa does require short day lengths for flowering; however, there have been successes growing quinoa in Colorado with plants having a wide range of maturity from 95 – 125 days (Johnson, 1985). Quinoa is a drought tolerant crop that can do well on coarse textured marginal soils.

See Appendix 6 for a more detailed overview of crop variety requirements.

Climate

The climate and soils in the West Kootenay are currently suitable for a wide range of vegetables, berries, some tree fruit and grains. Climate change projections indicate a substantial increase in the Frost Free Period (FFP) and Growing Degree Days (GDD) throughout the region, which will likely extend the growing season by approximately 30 to 90 days and increase the range of crops that can be grown.

Climate projections vary through the region with cooler, moister climates around Salmo, Nakusp and Lardeau with warmer drier climates around Trail, Creston and the Slocan Valley. All arable land will likely require increased irrigation with climate change, especially areas with the highest Climate Moisture Deficit (CMD).

All three Global Climate Models (GCM) climate models show an increase in temperature-related variables by 2050 for the FFP (Figure 14), GDD (Figure 15), and Mean Warmest Month Temperature (MWMT) (Figure 16). The climate scenarios that show the lowest temperature variables are substantial while the highest temperature projections show alarming increases (see Figures 16 & 17).

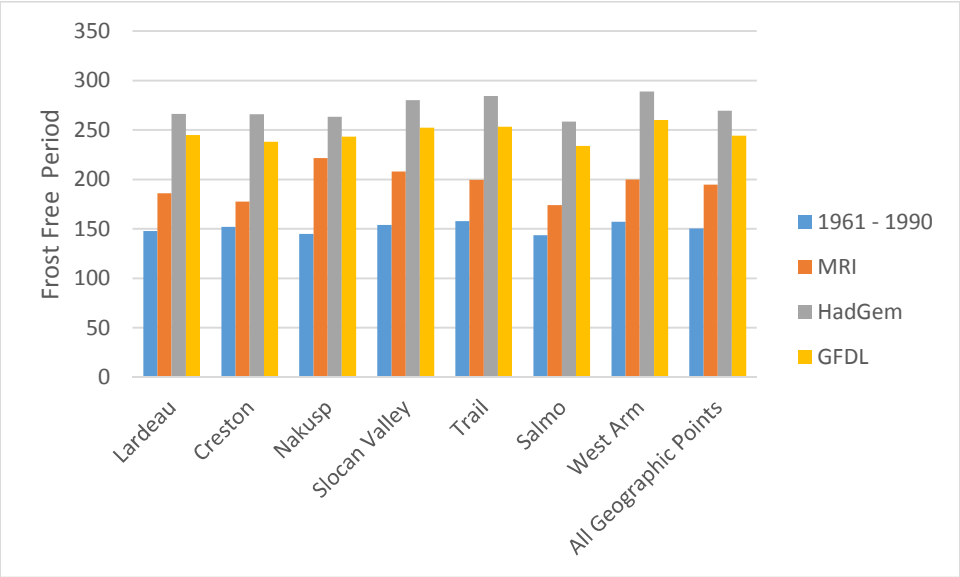
Refer to Table 3 for the GCM scenarios used.

The increase in the projected FFP illustrates the trend with increases from 17% with the MRI GCM up to 84% with the HadGem GCM (Figure 14). The MWMT is projected to increase by up to seven degrees in some areas (Figure 16). Mean temperatures for each season show an increase including the winter season (Figure 17).

Some areas are projected to have higher temperature related variables and some lower:

- Highest: Trail, Slocan Valley
- Medium: West Arm, Creston
- Lower: Salmo, Nakusp, Lardeau

Figure 14: Frost Free Period, 2050



("All geographic points" stands for all agricultural climate study areas combined)

Figure 15: Growing Degree Days (GDD) above 5^{0}C, 2050

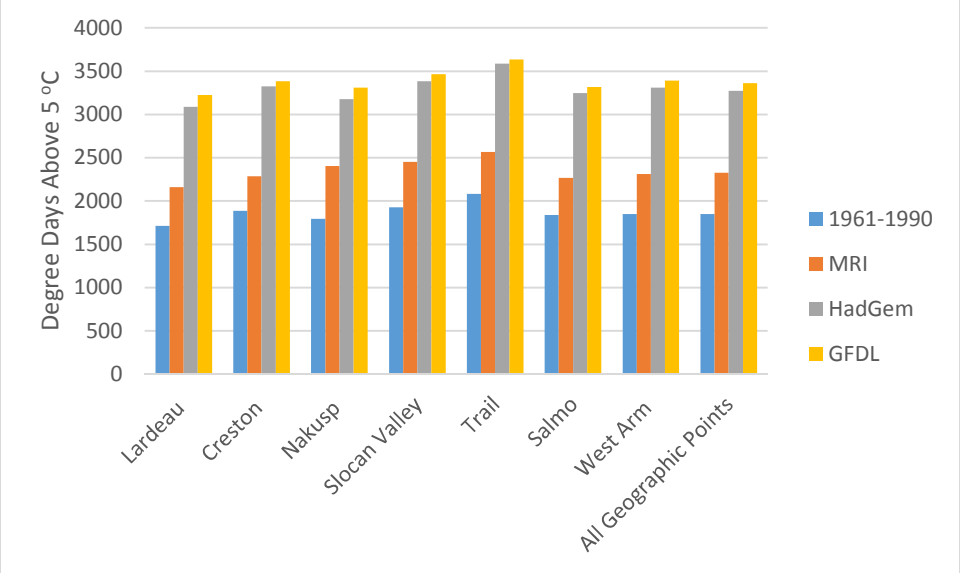


Figure 16: Mean Warmest Month Temperature (MWMT), 2050

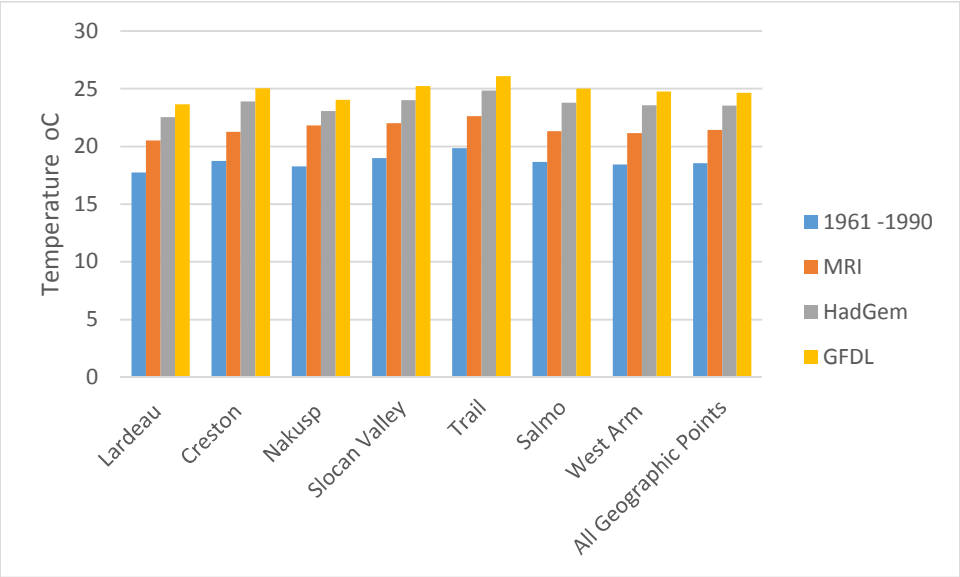
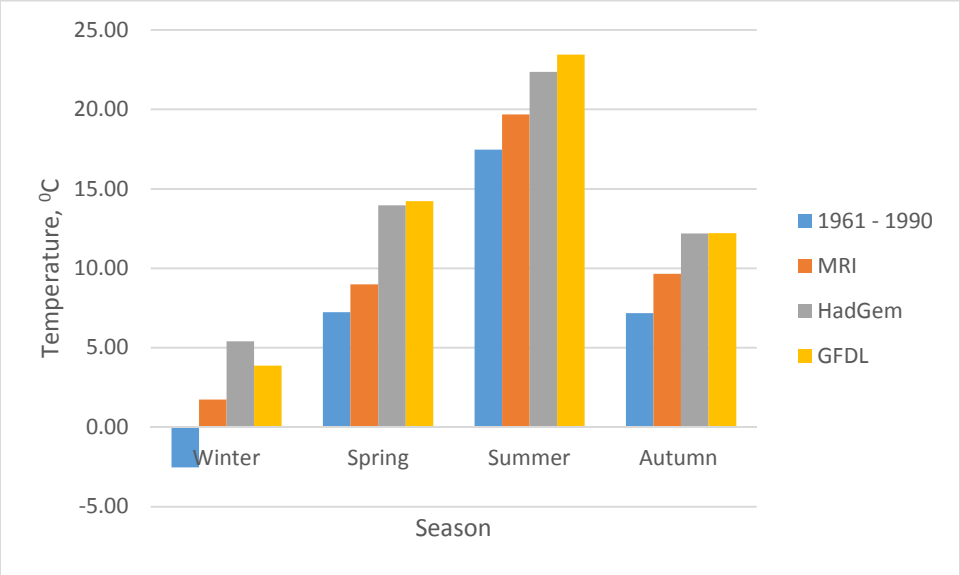


Figure 17: Seasonal Mean Temperature for all areas in the climate study area, 2050



Moisture

Summer precipitation and Climate Moisture Deficit (CMD) show more variability between climate scenarios than the projections related to temperature. The MRI and GFDL scenarios show an increase in summer precipitation for most areas and the HadGem shows a slight decrease (Figure 18). The annual CMD is projected to increase with the GFDL and HadGem scenarios but projected to decrease slightly with the MRI scenario (Figure 19). The seasonal projections for all agricultural areas combined show an increase in CMD in the summer season (Figure 20). Therefore, although summer precipitation may increase in some climate scenarios, the rise in temperature will likely result in increased moisture deficits for all areas but the extent of the dryness will depend on the amount of precipitation received in each area.

Some areas are projected to have more moisture deficit than others:

- More CMD: Creston, Trail, Slocan Valley
- Less CMD: Salmo, Lardeau, Nakusp, West Arm

Figure 18: Mean Annual Summer Precipitation (May – September), 2050

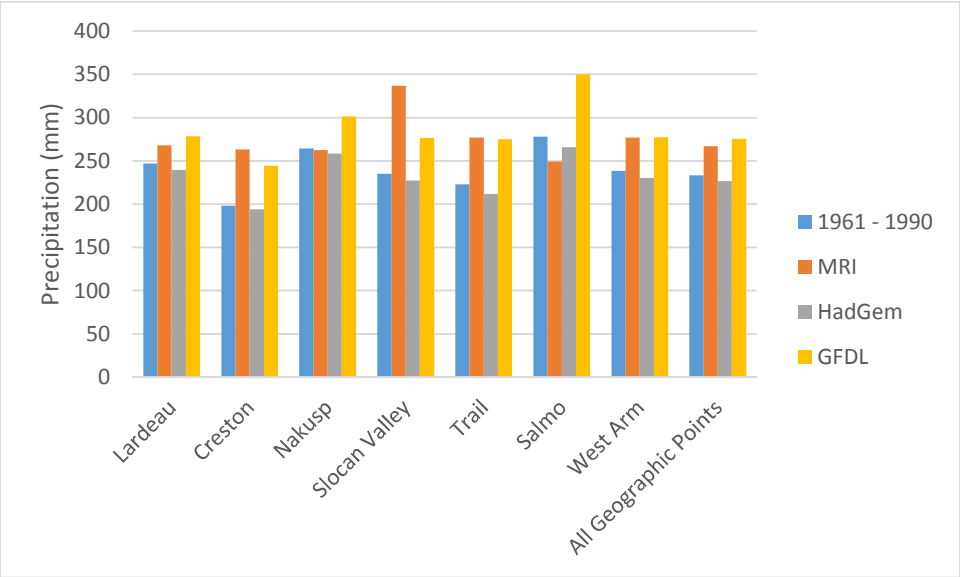


Figure 19: Annual Climate Moisture Deficit, 2050

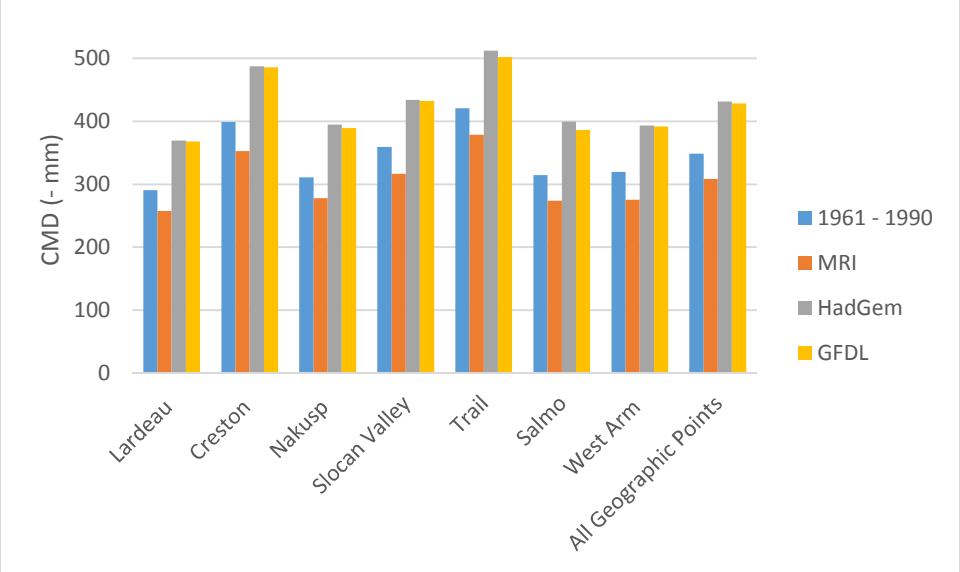
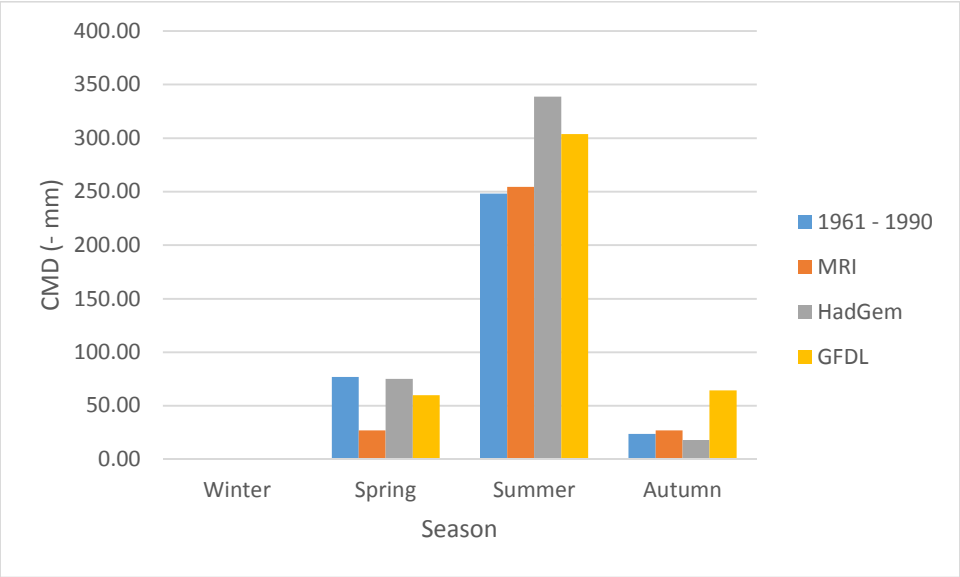


Figure 20: Seasonal Climate Moisture Deficit for all areas in the climate study area, 2050



Discussion

Farmers in the region currently produce a diversity of crops on a wide range of soils but the current climate limits the length of the growing season and the variety of crops that can be grown. Crops that have the potential for value added processing such as hops for beer and grapes for wine may be suitable for Class 4 - 5 soils in the region and the climate may become more favourable for tree fruits or niche crops such as grapes with climate change.

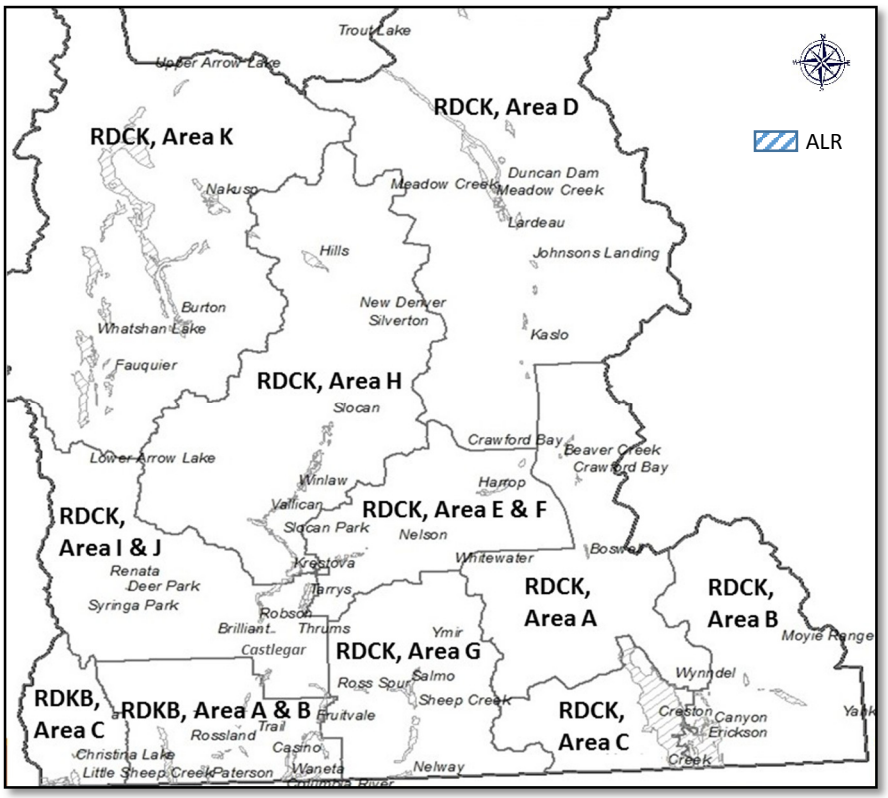
The Soil Capability data identifies the quality and location of agricultural land while the climate data suggests areas that may be more climactically suitable for specific crops which can support a strategic vison of agriculture in the region.

Agricultural Areas

Areas in the region that may have agricultural potential are outlined below and are based on the data in this report. The areas were chosen because of the land's agricultural capability, proximity to existing transportation corridors and perceived potential. Infrastructure, current land use and/or other barriers to farming were not considered.

The last chapter in this report includes detailed maps for each Regional District Area that shows agricultural land and primary limitations. The map below (Figure 21) is for reference for the following section.

Figure 21: Map of the study area showing Regional District Electoral Areas.



Perennial fruit trees, grapes, hops and annual crops that are suitable for coarse textured soils (Class 4 - 5 soils)
Limitations primarily include topography, low moisture holding capacity and stoniness

- Central Kootenay Area B: Creston East towards Yahk
- Central Kootenay Area H: Slocan Valley
- Central Kootenay Area J: Castlegar area*

- Kootenay Boundary Area B: Trail/Columbia Gardens

These areas have Class 4 - 5 soils and the warmest climate variables in the region including Frost Free Period (FFP) and Growing Degree Days (GGD). These soils are likely coarse textured, well-draining and suitable for perennial crops such as tree fruits, grapes, hops and annual crops that prefer marginal soils. These locations are drier than other areas in the region and have a higher Climate Moisture Deficit (CMD) meaning that these locations require irrigation for crop production. Vegetable crops will grow if soil conditions are improved for nutrient and moisture holding capacity.

The area East of Creston has a large tract of Class 4 land in the ALR, while many areas of the Slocan Valley are in the ALR. The Trail and Columbia Gardens area currently has two vineyards for wine.

**Climate projections were not conducted for Castlegar. Proximity to Trail and the Slocan Valley is 40 km.*

Mixed vegetables, berries and tree fruits (Class 1 - 3 and 4 soils)
Limitations primarily include low water holding capacity, topography and stoniness

- Central Kootenay Area E: West Arm Kootenay Lake (Harrop/Proctor)
- Central Kootenay Area J: East of Castlegar (Thrums/Tarry's)

The West Arm of Kootenay Lake is projected to have a long FFP comparable to the Slocan Valley and Trail and more precipitation than the hottest areas in the region (such as the Slocan Valley and Trail). The area has Class 3 lands in the ALR suitable for a wide range of crops and Class 4 lands that are limited by a low moisture holding capacity.

East of the City of Castlegar exists prime agricultural land along the main transportation corridor between the City of Castlegar and the City of Nelson. Stoniness and a low water holding capacity can be overcome with irrigation and the land is likely suitable for a wide range of crops including tree fruits, vegetables, berries and potentially field crops.

Crops that require cooler conditions at higher elevations (Class 4 - 5 soils)
Limitations primarily include low moisture holding capacity, stoniness and topography.

- Central Kootenay Area H: Summit Lake
- Kootenay Boundary Area B: Paterson (south of Rossland)

Land around Summit Lake and Rossland has Class 4 and 5 soils in the ALR. Crops that require cooler temperatures such as hardy vegetables and specialty crops such as quinoa may be suitable for these areas.

Field crops and mixed vegetables (Class 1 - 3 and 4 soils)

- Central Kootenay Area D: Meadow Creek/Lardeau North
- Central Kootenay Area K: Nakusp area and Burton
- Central Kootenay Area G: Salmo area

These areas are characterized by cooler climates and prime agricultural land. Central Kootenay area D has 16% of the total Class 1 - 3 land (concentrated north of Lardeau and Meadow Creek). Much of the Class 1 – 3 land is limited by climate, which will likely improve with climate change. Field crops, potatoes and mixed vegetables are most suited for the prime agricultural soils that have fewer stones and a higher moisture holding capacity than many of the Class 4 and 5 soils in the region.

Central Kootenay area K includes the Village of Nakusp, Burton and Fauquier with 29% of the region's prime agricultural land and the highest percent of ALR in the region. Limitations include undesirable soil structure, low moisture holding capacity, stoniness and topography. Large tracts of ALR and high capability soils exist in the North West portion of the

area but are remote and potentially hard to access. The main limitation on Class 3 soils in the area is low moisture holding capacity.

The Salmo River flood plain has historically been an area associated with frostiness and a short FFP but it has flat Class 4 land in the ALR on a main transportation corridor. An increase in the FFP will likely improve the agricultural capability of this area.

Field crops, grain, tree fruits, grapes (Class 1 - 3 soils)

- Central Kootenay Areas B & C: Creston Area

The Creston area already has an established agricultural sector and already utilizes much of its agricultural land. Central Kootenay area C has the majority of the Class 1 - 3 land, which is used for field crops and grazing where Area B includes the areas of Erickson and Canyon that specialize in tree fruits. Area C is most suited for field crops that use mechanized farm machinery because of the large tracts of flat, arable land. Climate projections indicate an increase in the FFP and GGD which could increase the range of tree fruits and grains that can be produced and drier conditions may create higher demands for irrigation during the growing season. Projections of increased summer precipitation could be negative for some tree fruits and grains.

Water

Water should be a key consideration for crop production in the future. Irrigation is already required for most arable crop production in the region and a longer growing season with warmer temperatures will likely increase irrigation requirements. Depending on the source and availability of local water supplies, irrigation for agriculture could stress water resources.

From a broader perspective, access to a reliable water supply could give the region an advantage over areas that are more water stressed such as the East Kootenay, Kootenay Boundary and the Okanagan. The East Kootenay is more arid than the West Kootenay and projected to become drier with climate change. Agriculture in the Kootenay Boundary region is reliant on the Kettle River Watershed, which is threatened by late summer low flows and competing demands for water supply (Regional District of Kootenay Boundary, 2012). The Okanagan has the lowest water supply per person in Canada where agriculture accounts for 55% of total water use and demand for water is likely to increase in the future (Okanagan Basin Water Board, 2013). In the future, agriculture may be better suited for areas with water than with the best agricultural land.

Next steps

Land use and feasibility assessment

An agricultural land use assessment of the ALR similar to the land use survey conducted by the Regional District of East Kootenay (Regional District of East Kootenay, 2013) would inform how much of the ALR is currently in use and therefore how much is potentially available for production.

A general land use study of all areas that have agricultural potential (Class 1 – 5 lands) would provide information on capable lands not in the ALR that may be available for agriculture. This assessment could also develop feasibility parameters to understand the realistic potential for agricultural development, including such things as accessibility and access to irrigation.

Climate Capability for Agriculture Ratings

Soil Capability for Agriculture Classifications consider climate in the classification system. Climate ratings are outlined in the Climate Capability Classification for Agriculture in British Columbia report (Climatology Unit, 1981). Climate change has the potential to change some Climate Capability ratings and could therefore change the agricultural Capability Classes 1- 7 in the region (see Appendix 3 for an overview of Climate Capability Ratings). It would be helpful to the agricultural sector and new entrants to farming if the Climate Capability ratings this were updated for the whole province to include the most recent climate conditions and future climate projections.

Water supply and demand for agriculture

A thorough examination of water supply and demand for agriculture including the need for the evaluation of water storage requirements in each area is necessary to inform the feasibility for agricultural development in the region.

Food Security

Accounting for small scale food production such as the backyard garden needs to be better understood to fully understand the capacity of the region to be food self-sufficient.

Conclusions

The boundaries of the ALR protect 66,000 ha of the most valuable land for agriculture in the West Kootenay, with enough land to feed about 130,000 people or nearly double the current population. The region's capacity to feed itself is actually much greater as the region has a total of 86,000 ha of class 1- 4 land that can support a wide range of crops and 113,000 ha of class 5 that is suitable for forage, animal pasture and specialty crops, which given climate change projections for 2050, have enormous potential for niche crops such as grapes.

Today, however, only 10% of suitable agricultural land (31% of the ALR) is actually used for crops or pastures, thus the West Kootenay is well situated to increase its food security and meet the market demand for locally produced foods.

Both climate and soils offer opportunities for mixed small scale agriculture and an informed approach to increase agricultural production in the region may inspire more people to enter the farming sector, remove barriers and maximize success rates.

Soil Capability for Agriculture Maps

Based on the Soil Capability for Agriculture Maps, Canada Land Inventory, 1972

The following maps highlight areas in the region with agricultural capability and complement the information in the report "Agriculture Potential of the West Kootenay." The maps are based on the weighted average of Soil Capability for Agriculture Classification (refer to the the methodology section of this report).

Jpeg images of the original 1:125,000 Soil Capability Maps for Canada can be found at this link: http://sis.agr.gc.ca/cansis/publications/maps/cli/250k/agr/

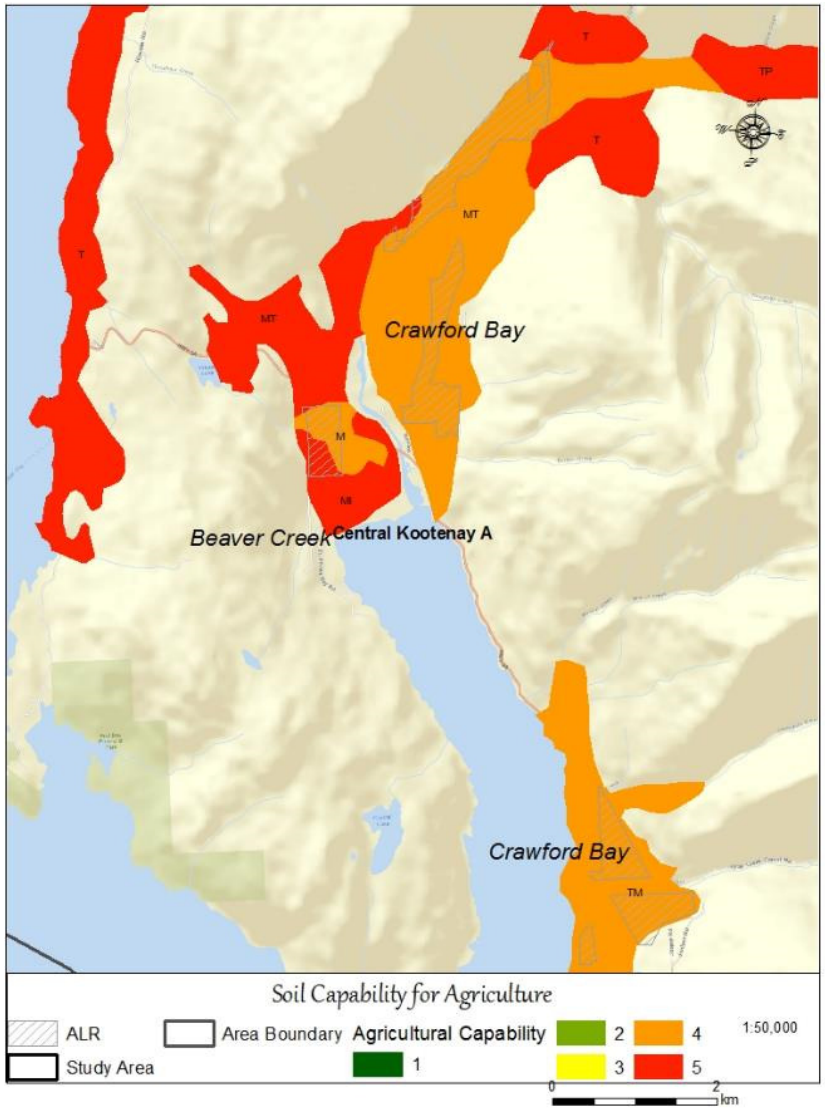
Capability Classes are defined by colours and limitations are noted on the land pieces. Because of the low resolution of the jpeg images, the entire Regional District area was not displayed in order to clearly highlight areas that have the most significant amount of agricultural land. PDF images of the entire Regional District Area are clear and in the meantime can be requested from Rachael Roussin (rachael.roussin@gmail.com).

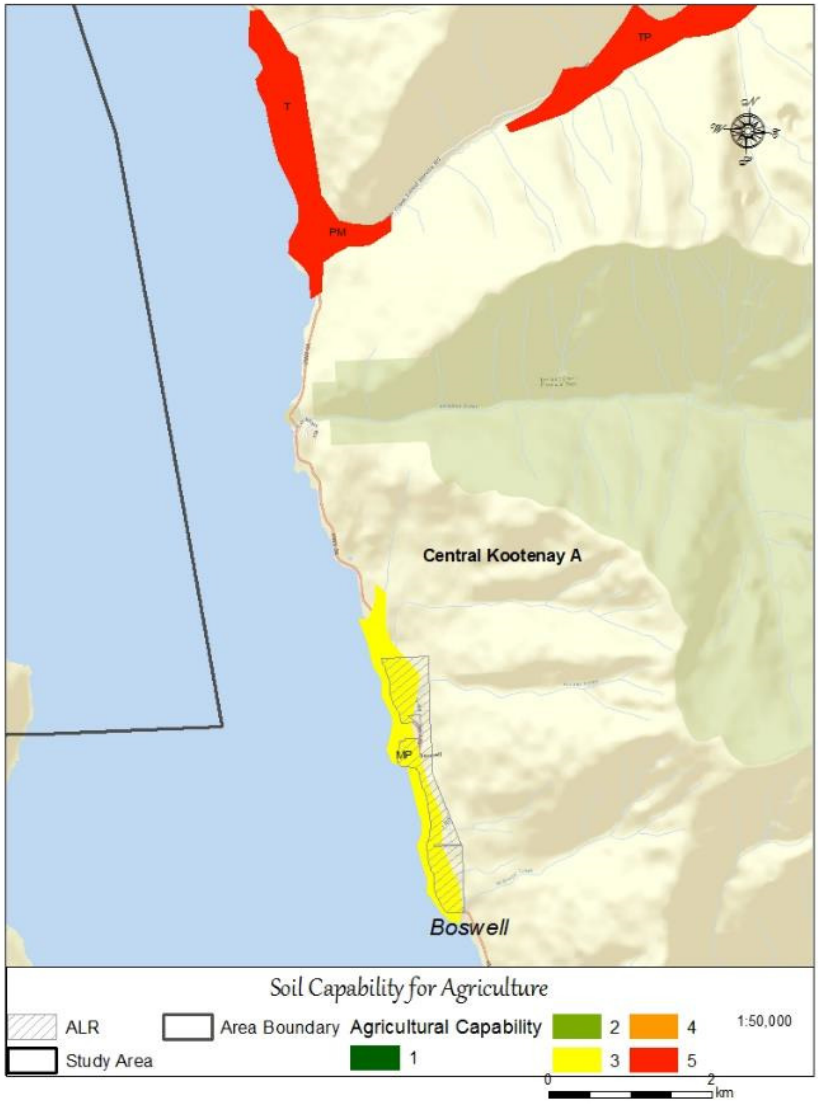
The maps are organized by Regional District Area and the information includes total hectares of soil capability Class 1-3, Class 4-5 land, land in crops (Ha Crops) and land in the Agricultural Land Reserve (ALR).

Legend: Capability Subclasses for Primary Limitations	
C	Climate
D	Undesirable soil structure
E	Erosion damage
F	Fertility (low fertility)
I	Inundation by streams or lakes
M	Moisture holding capacity
N	Salinity
P*	Stoniness
R	Depth to solid bedrock
T*	Topography
W	Excess water
X	Cumulative minor adverse characteristics

Central Kootenay A

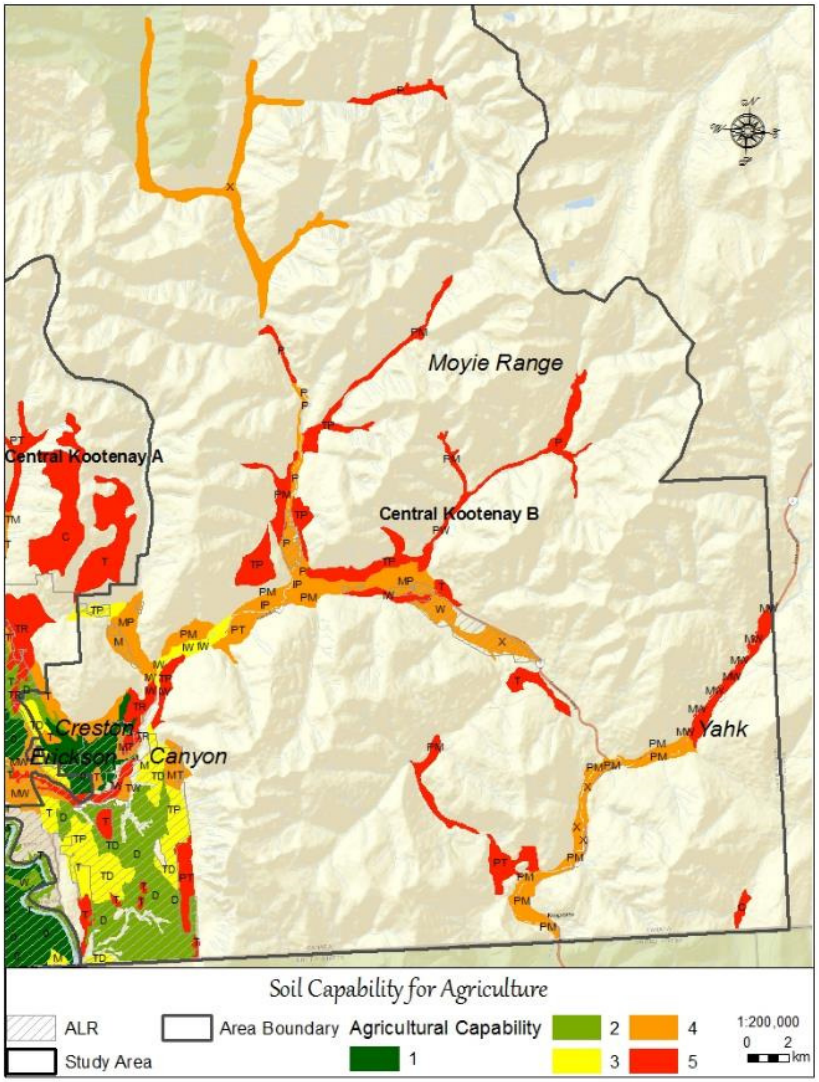
Area	Soil Class 1 – 3 (ha)	Soil Class 4 – 5 (ha)	Total ALR (ha)	Farms Reporting	In crops (ha)
Central Kootenay A	124.0	9,138.9	492.9	19	68

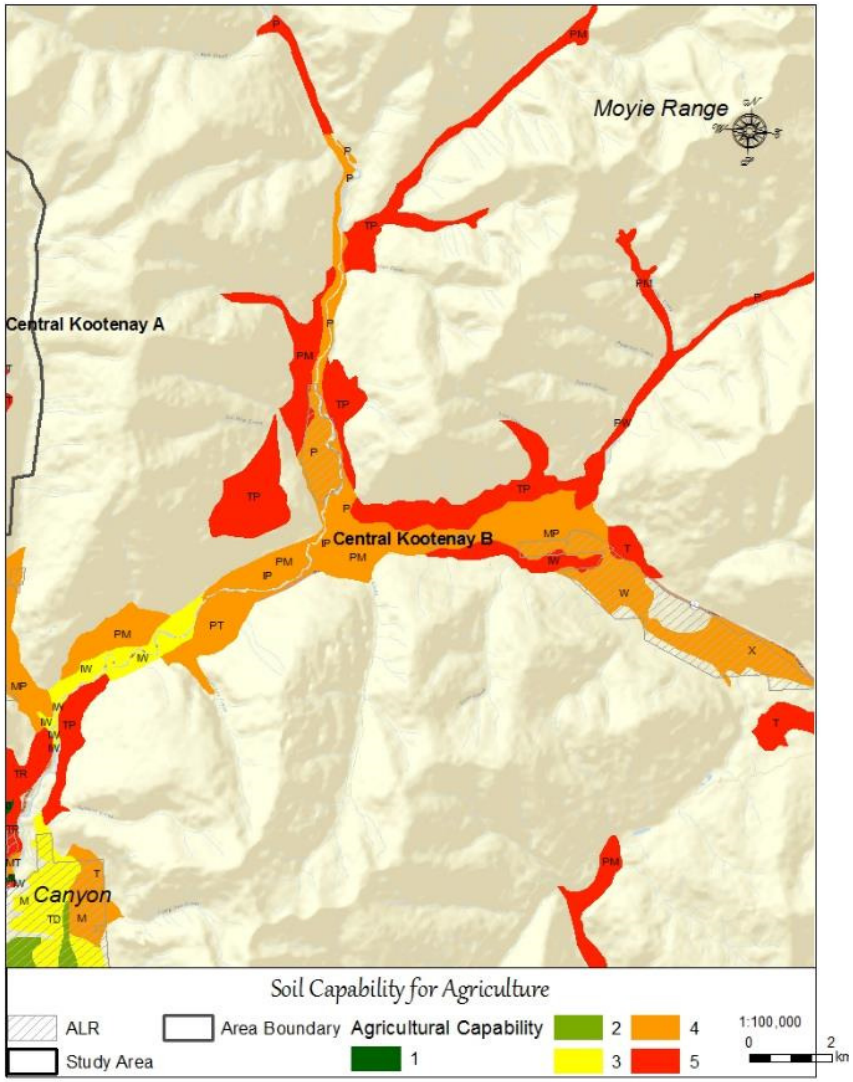




Central Kootenay B

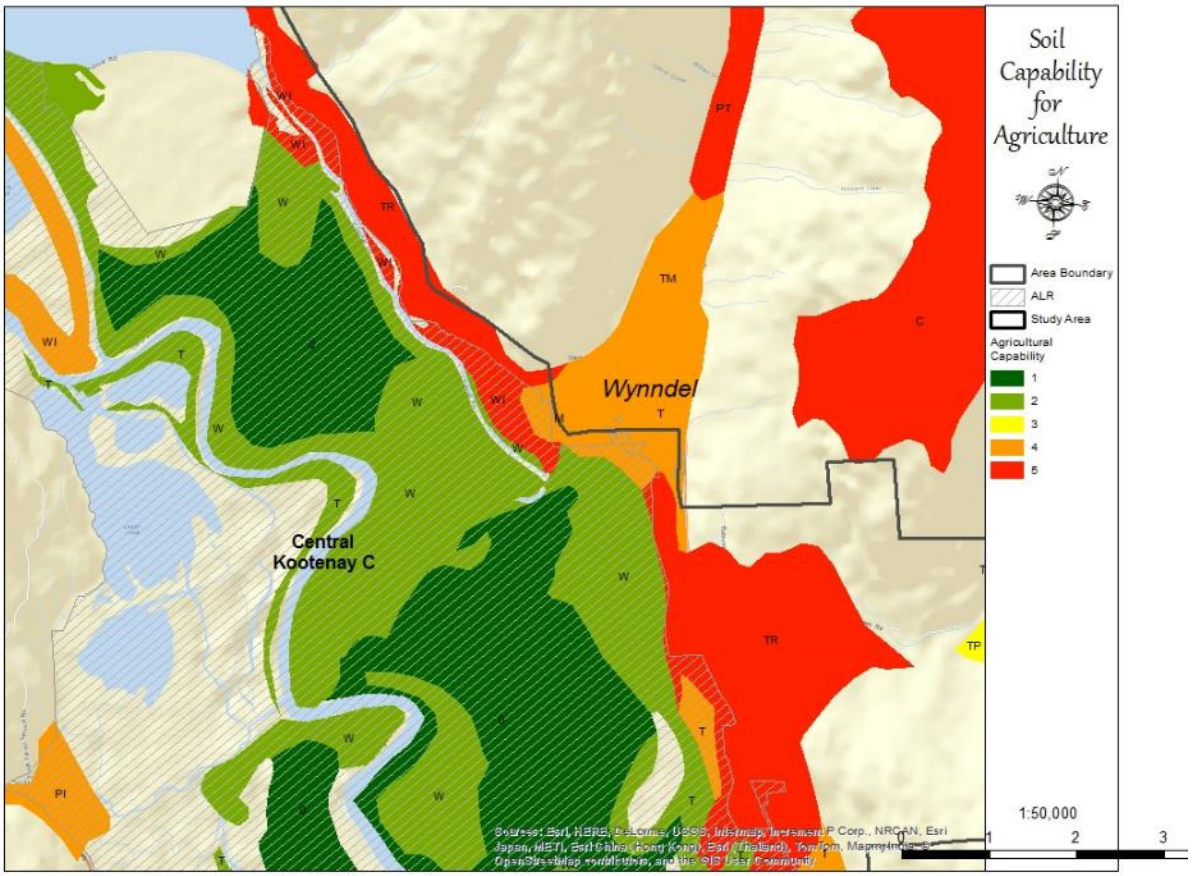
Area	Soil Class 1- 3 (ha)	Soil Class 4 – 5 (ha)	Total ALR (ha)	Farms Reporting	In crops (ha)
Central Kootenay B	5,763.5	10,706.6	7,375.2	171	4,560

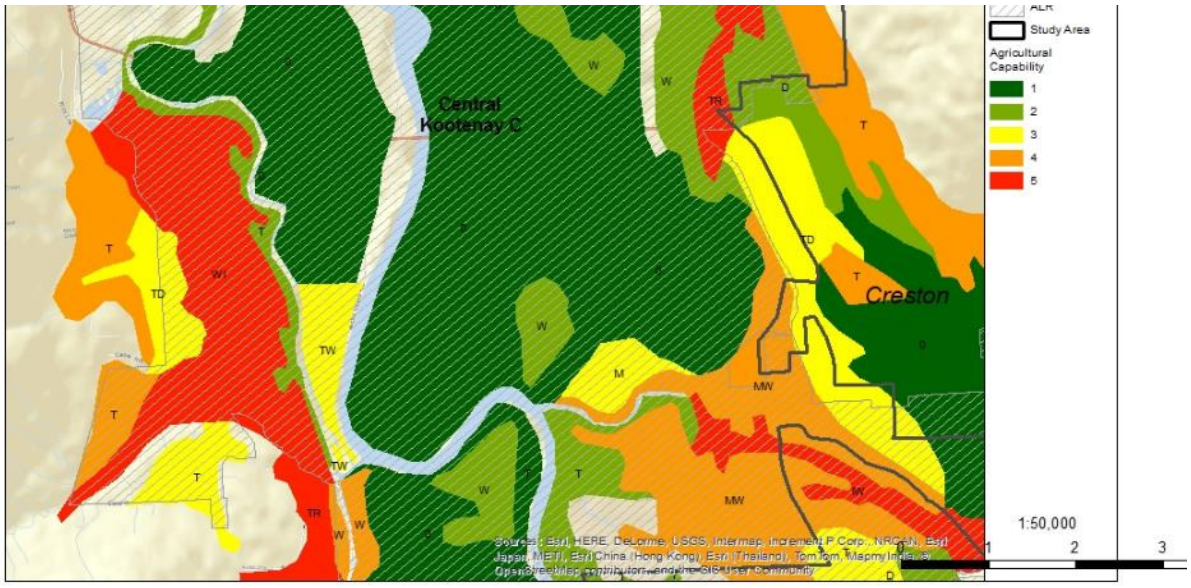




Central Kootenay C

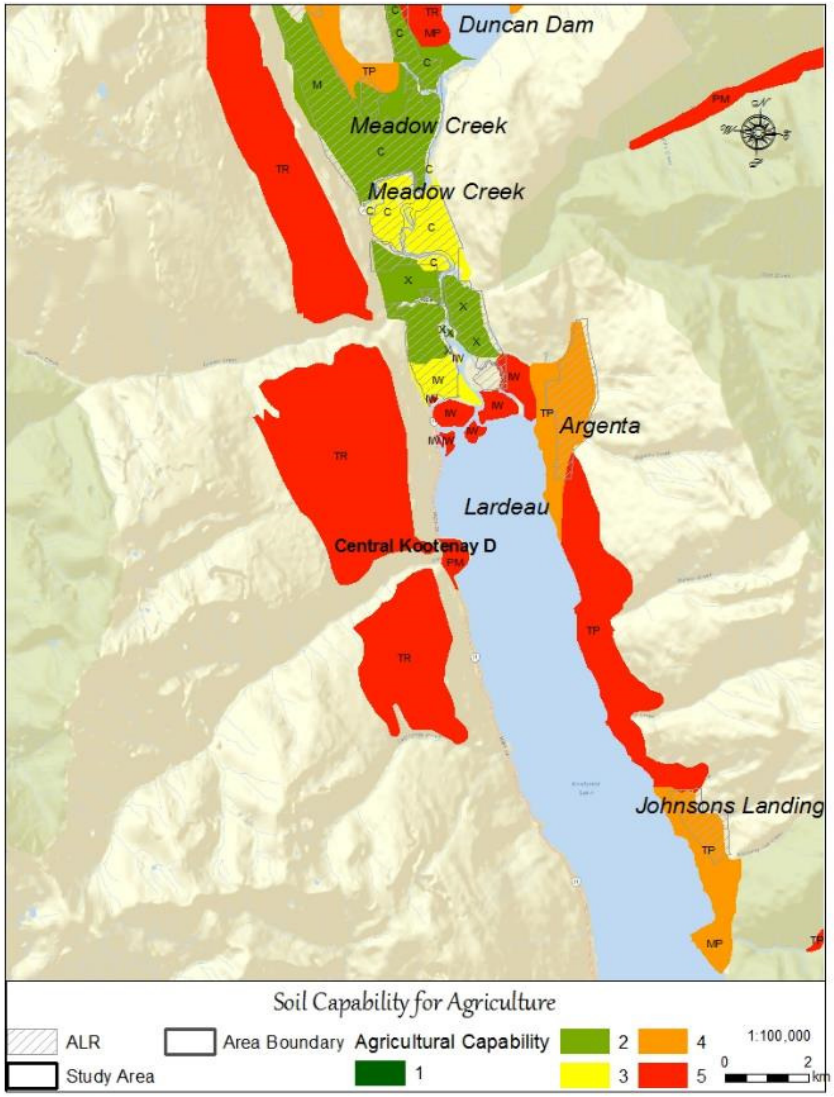
Area	Soil Class 1- 3 (ha)	Soil Class 4 – 5 (ha)	Total ALR (ha)	Farms Reporting	In crops (ha)
Central Kootenay C	9,235.6	5,437.0	12,110.6	50	4,352

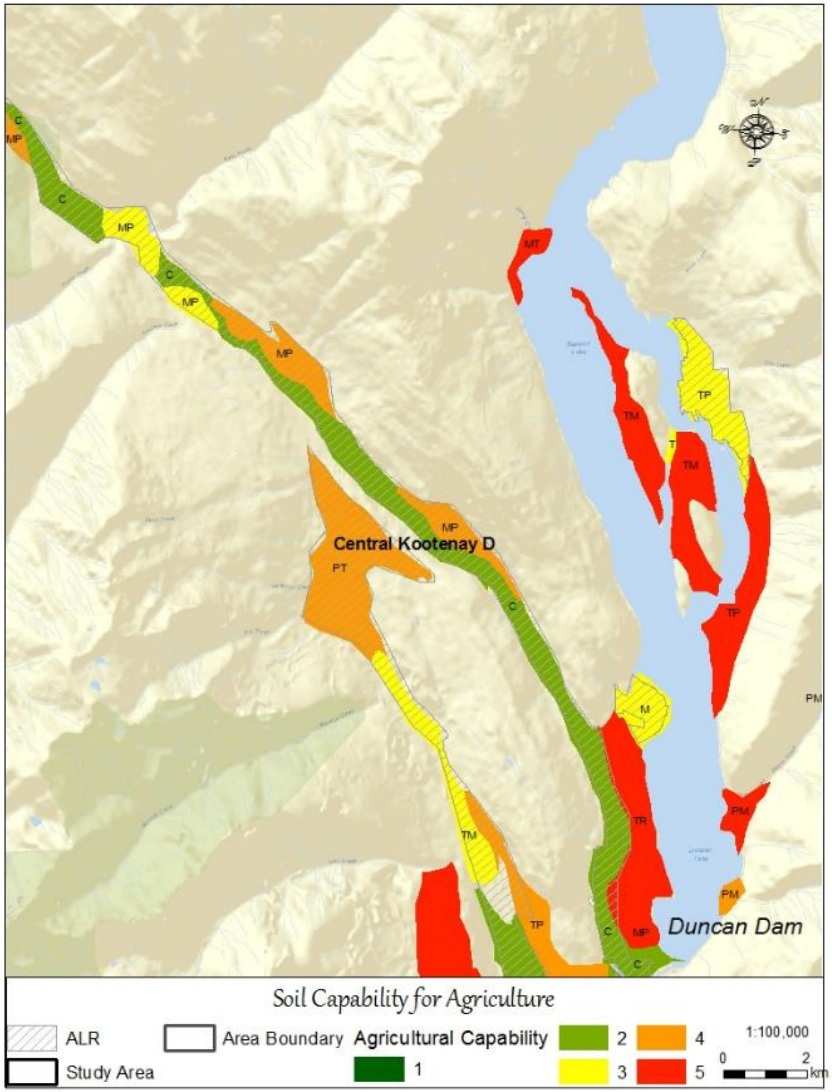




Central Kootenay D

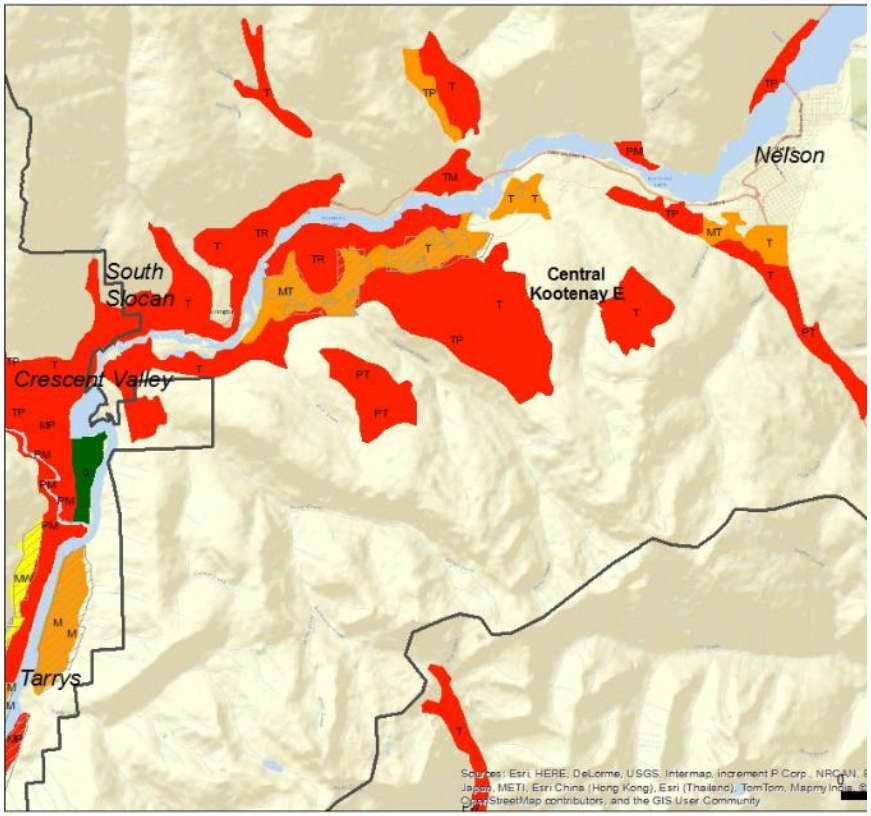
Area	Soil Class 1- 3 (ha)	Soil Class 4 – 5 (ha)	Total ALR (ha)	Farms Reporting	In crops (ha)
Central Kootenay D	5,205.2	16,300.2	7,295.5	14	177

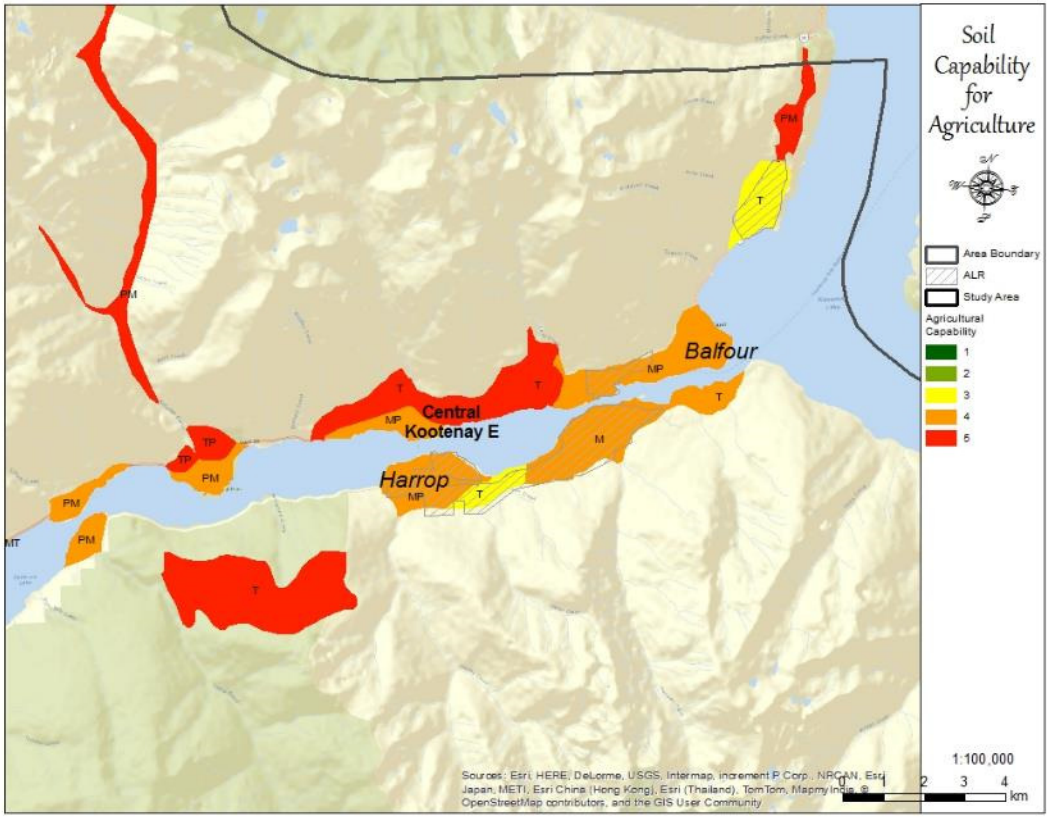




Central Kootenay E & F

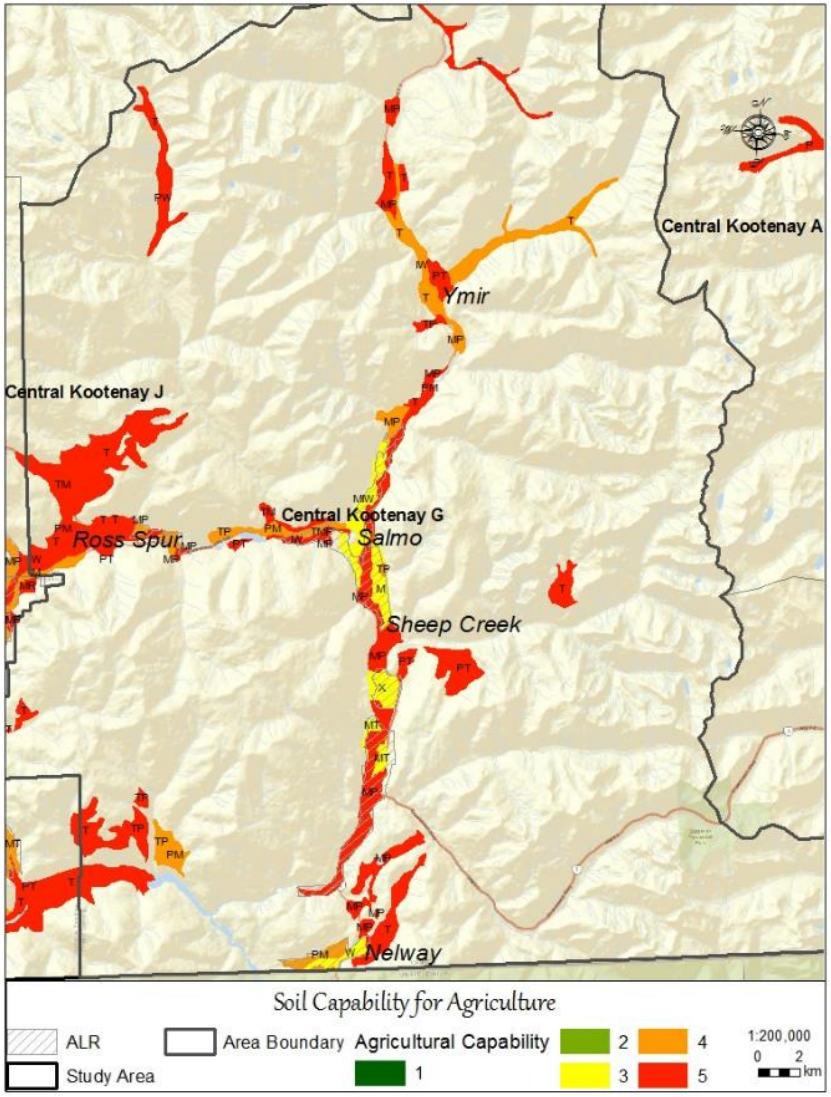
Area	Soil Class 1- 3 (ha)	Soil Class 4 – 5 (ha)	Total ALR (ha)	Farms Reporting	In crops (ha)
Central Kootenay E & F	271.8	8,373.6	1,124.6	29	299

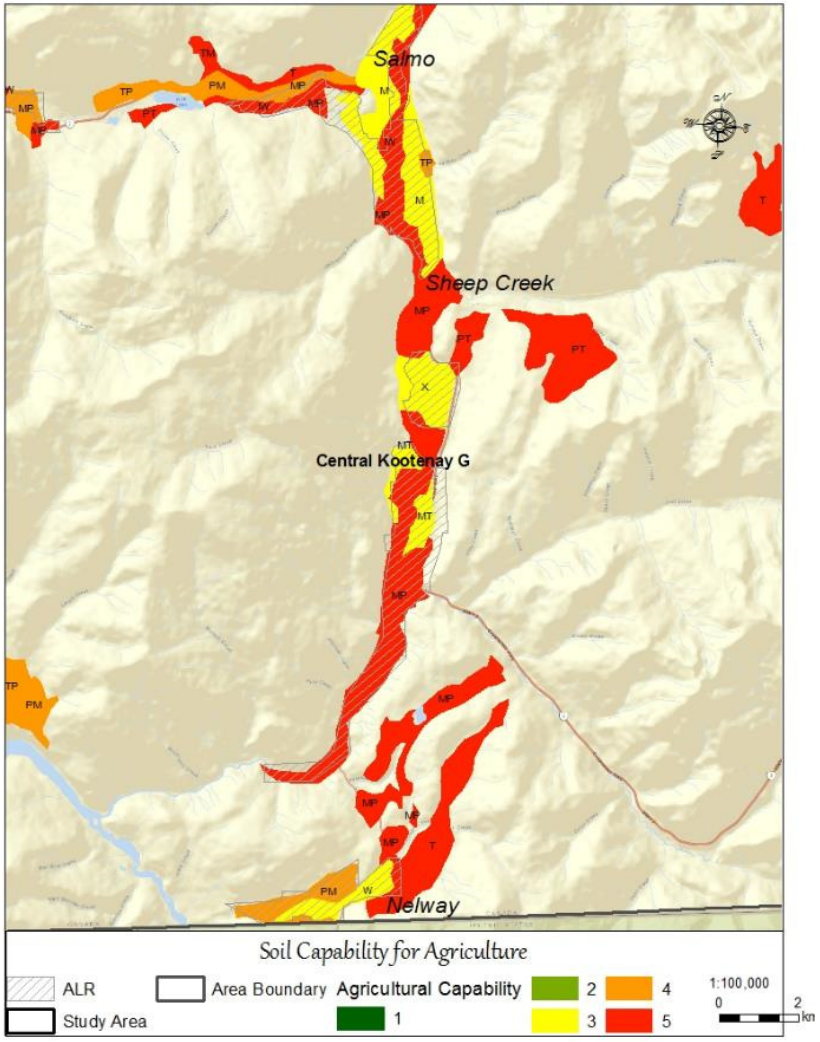




Central Kootenay G

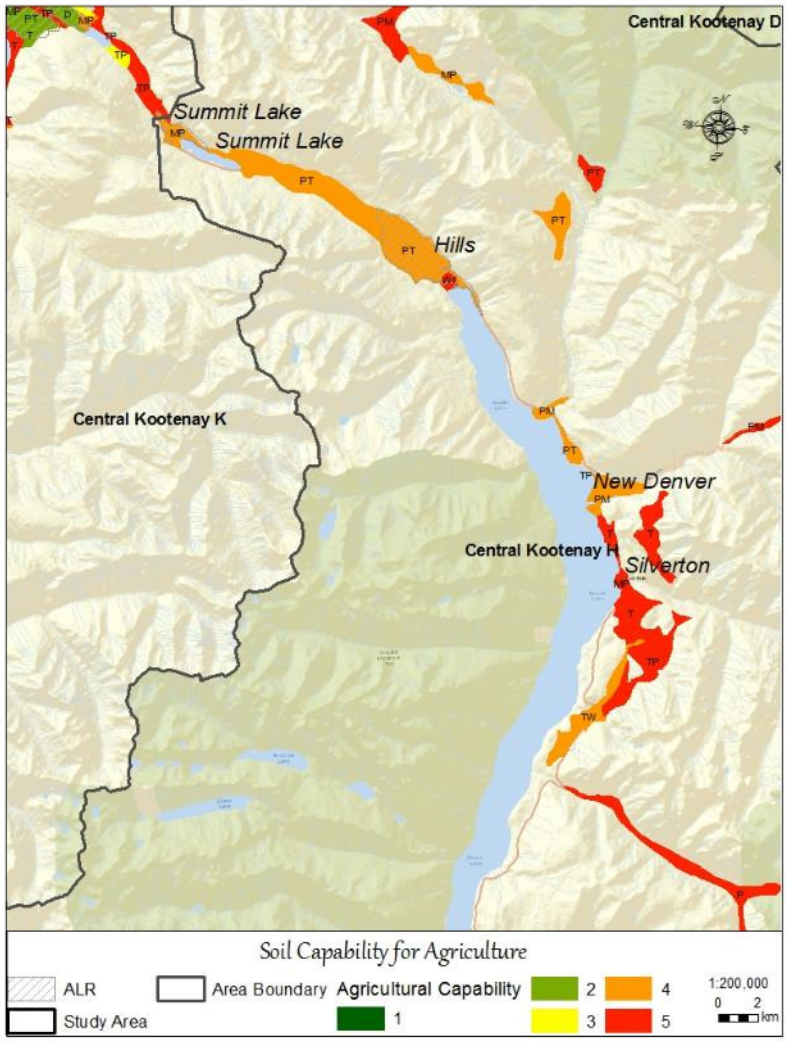
Area	Soil Class 1 – 3 (ha)	Soil Class 4 – 5 (ha)	ALR (ha)	Farms Reporting	In Crops (ha)
Central Kootenay G	1,139.4	10,058.6	2,431.1	14	189

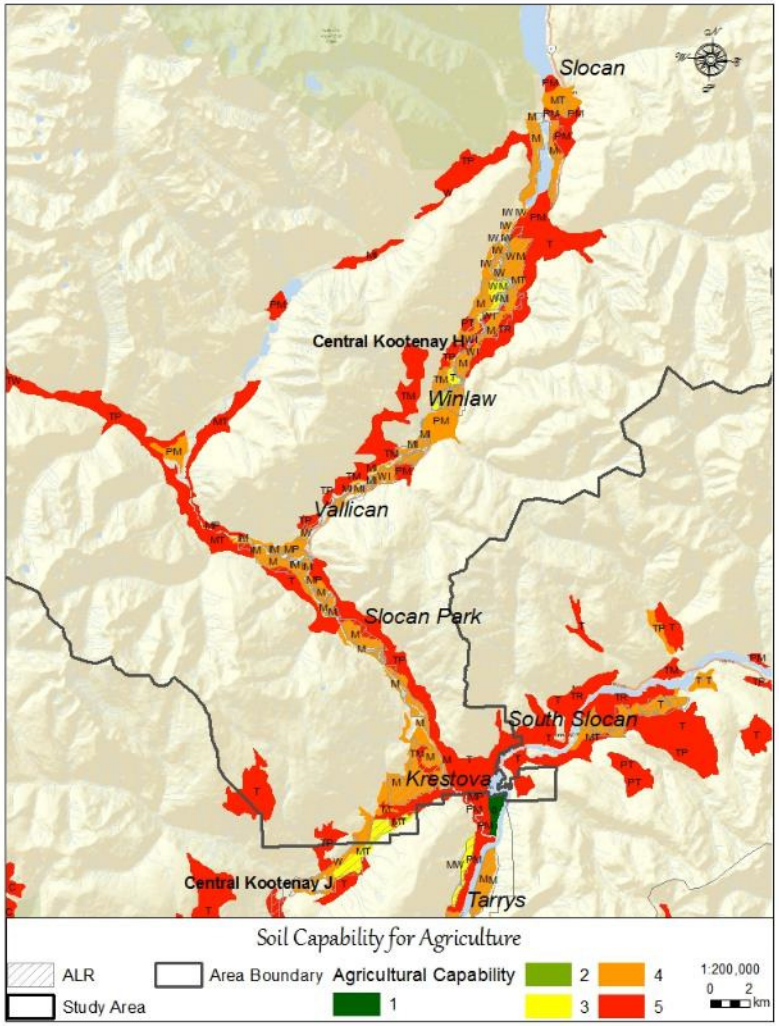




Central Kootenay H

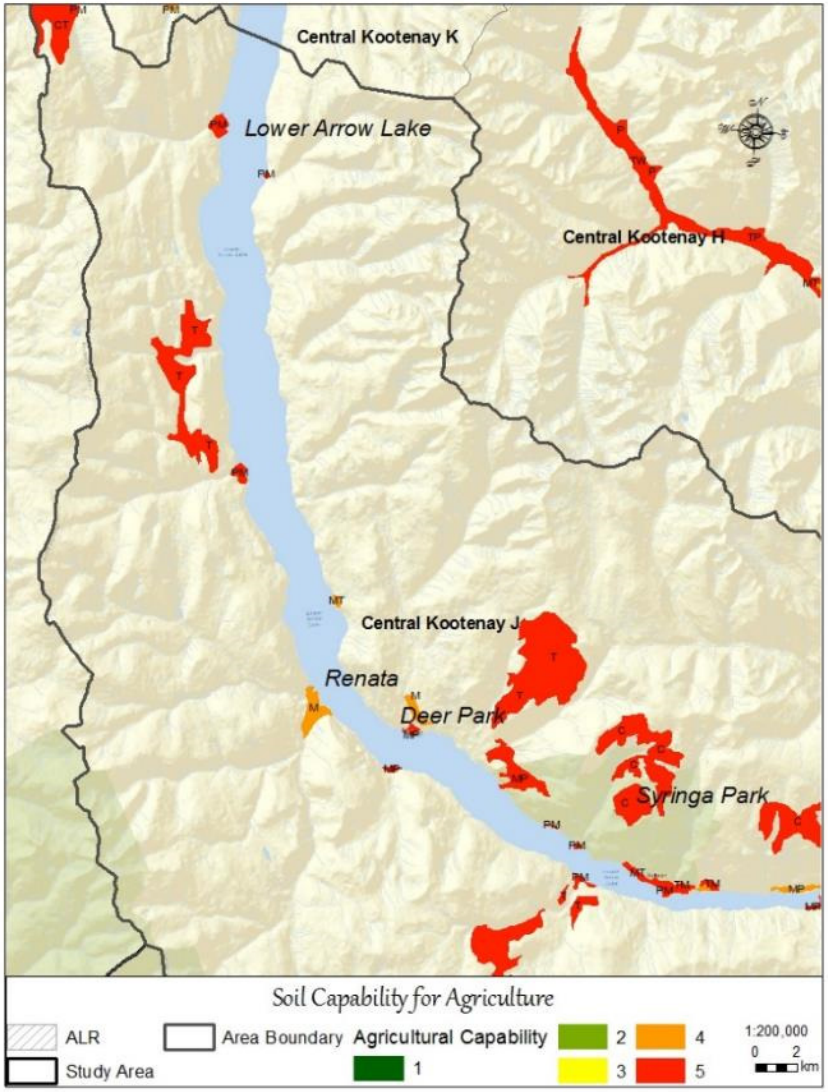
Area	Soil Class 1 – 3 (ha)	Soil Class 4 – 5 (ha)	ALR (ha)	Farms Reporting	In Crops (ha)
Central Kootenay H	329.3	18,687.9	4,427.6	56	325

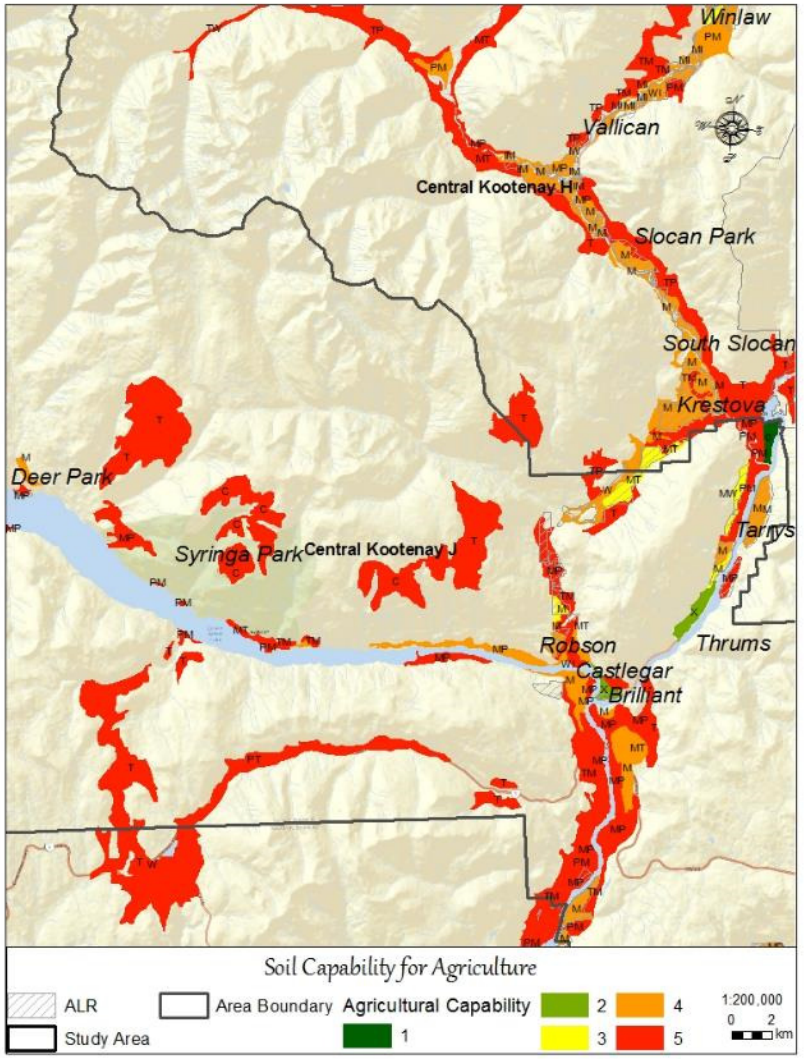




Central Kootenay J & I

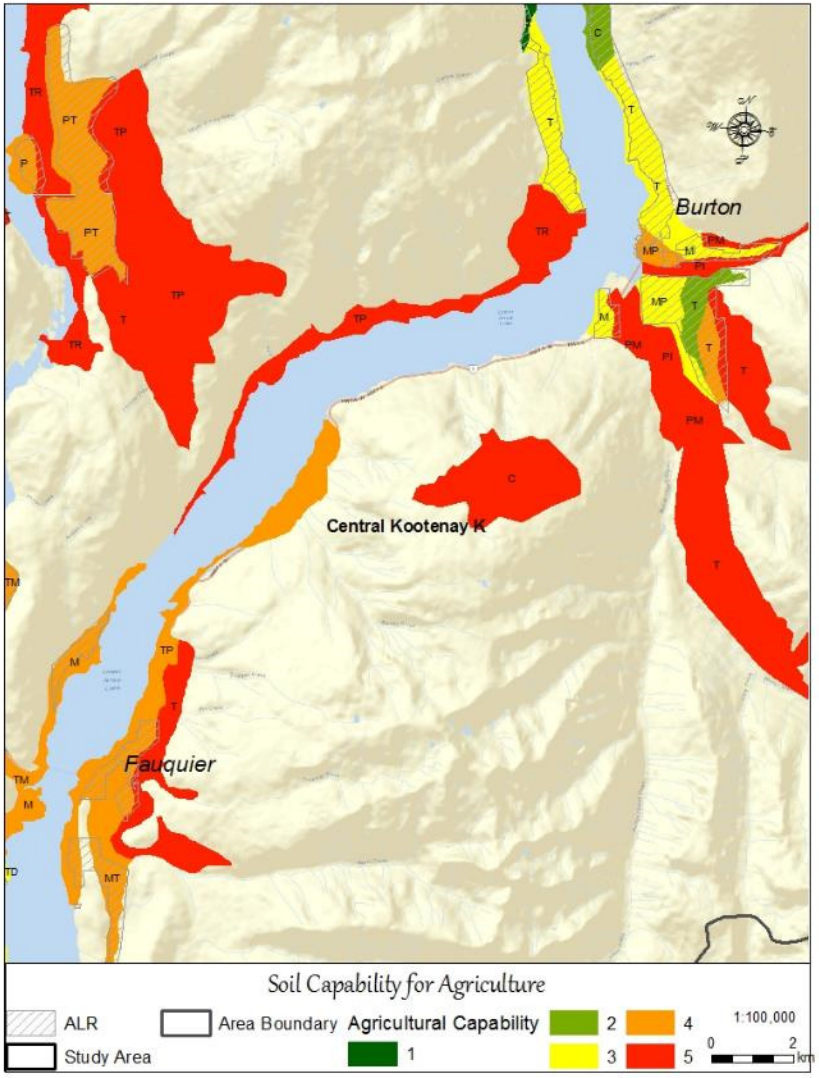
Area	Soil Class 1 – 3 (ha)	Soil Class 4 – 5 (ha)	ALR (ha)	Farms Reporting	In Crops (ha)
Central Kootenay J & I	750.8	16,455.2	1,852.0	27	112

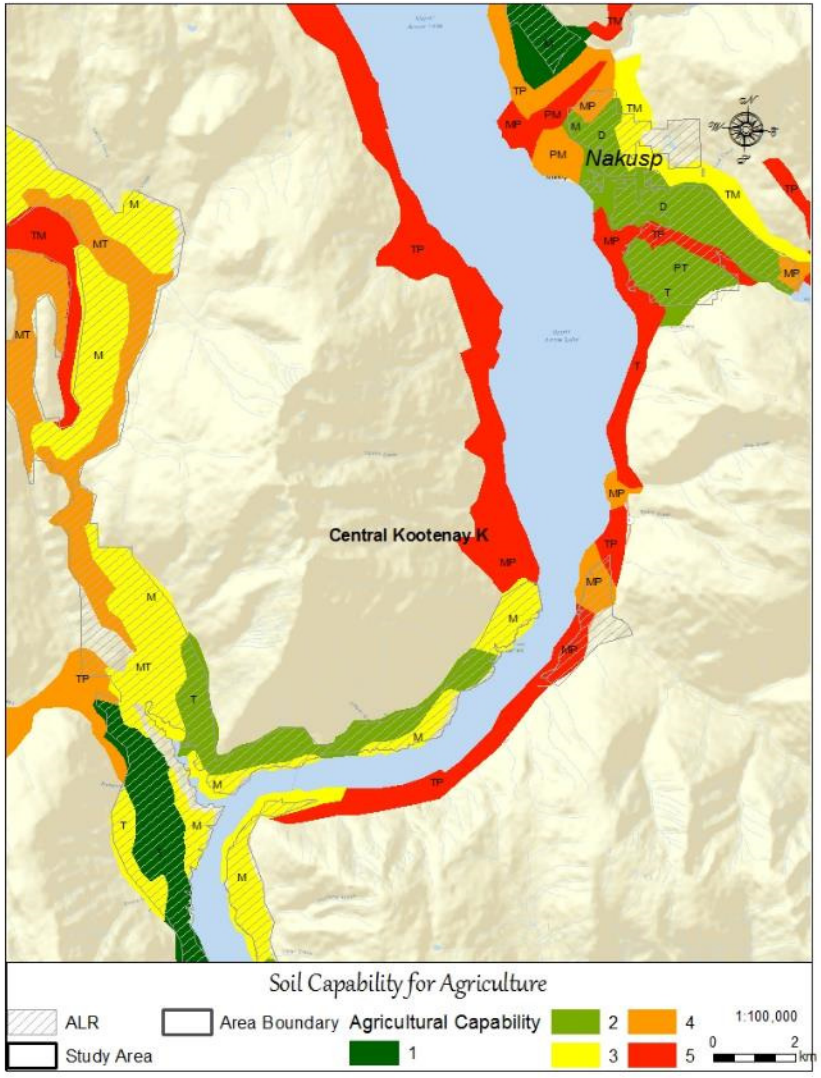




Central Kootenay K

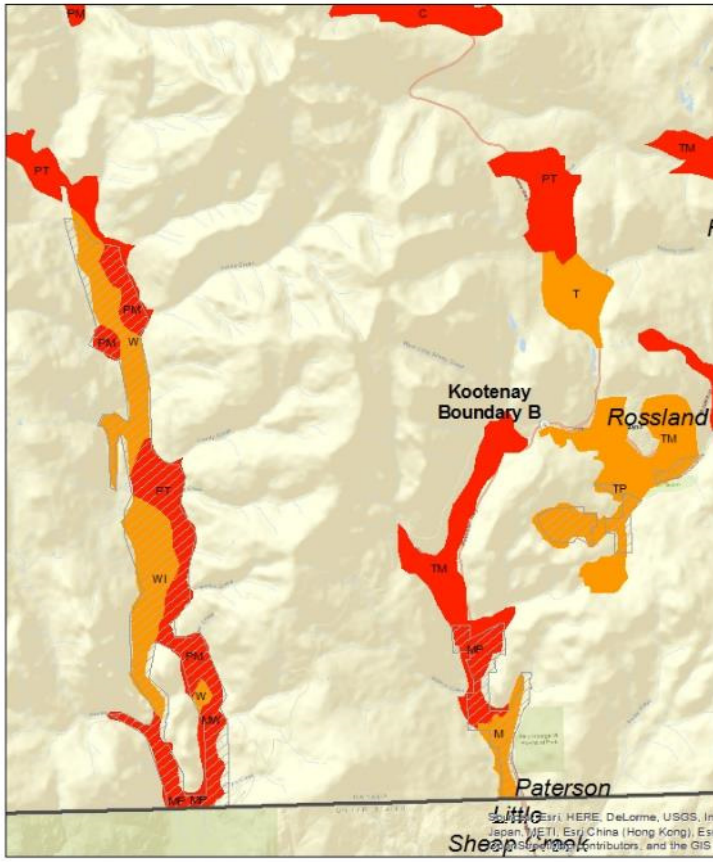
Area	Soil Class 1 – 3 (ha)	Soil Class 4 – 5 (ha)	ALR (ha)	Farms Reporting	In Crops (ha)
Central Kootenay K	9,559.8	50,667.5	22,804.0	48	959

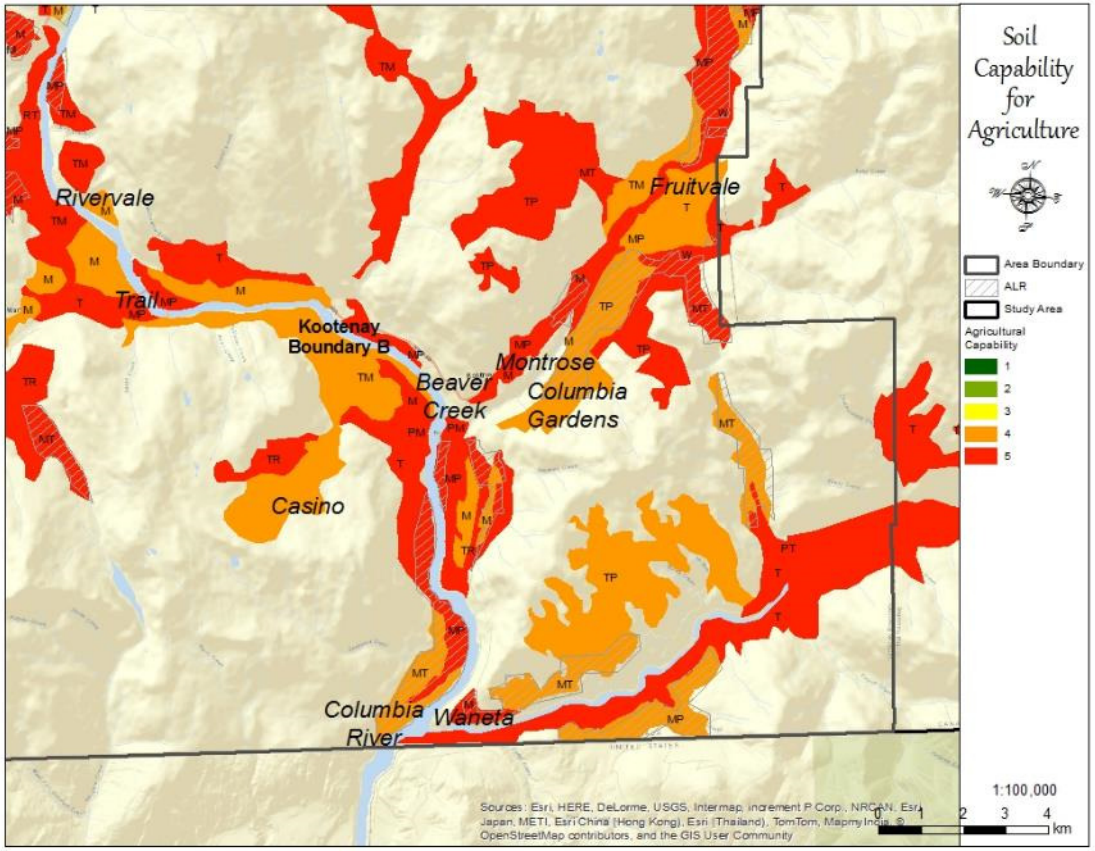




Kootenay Boundary A & B

Area	Soil Class 1 – 3 (ha)	Soil Class 4 – 5 (ha)	ALR (ha)	Farms Reporting	In Crops (ha)
Kootenay Boundary B	0.0	17,735.1	5,824.4	27	277





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Appendices

APPENDIX 1: B.C.'s Food Self-Sufficiency

A study conducted in 2006 by the B.C. Ministry of Agriculture and Lands assessed BC's food self-sufficiency from a land based perspective by using primary production (farm gate production) rather than wholesale values to estimate the amount of land required for BC to be food self-reliant. Given the production technology available today, over half a hectare of farmland (0.524 ha) is needed to produce the food for one person for one year.

The study estimated that B.C. farmers produce 48% of all foods consumed in B.C. and produce 56% of foods consumed that can be economically grown in B.C. Of that BC is 43% self-reliant for vegetables, 159% self-reliant for fruits that are grown in BC and 14% self-reliant for grain (B.C. Ministry of Agriculture and Lands, 2006).

Hectares needed to produce a healthy diet for one person (Ha)			
	Raw Weight/year	**Yield/Ha/year**	**Ha (green irrigated)**
Dairy	262L	13,000L	.020
Grain (for animals)			.048
Meat	68.6 kg		.394
Grains	51.1 kg	1,750 kg	.029
Vegetables	82.1 kg	6,600 kg	0.0177
Fruit	.0152	116 kg	.0152
Total non-irrigated			**.471**
Total irrigated			**.053**
Total Ha			**0.524**
Total for veg, fruit and grains ONLY			.082

Consumption of fruit and vegetables in BC (kg)			
Food group	**BC Consumption (millions KG)**	**BC Production (millions KG)**	**% Self Reliant**
Vegetables – Grown in BC	764	331	43%
Fruit – Grown in BC	172	273	159%
Vegetables – not grown in BC	1		0
Fruit – not grown in BC	310		0

2006, B.C. Ministry of Agriculture and Lands, B.C.'s Food Self Reliance

APPENDIX 2: Climate Capability for Agriculture in BC/Historic Climate

Climate Capability Classifications for Agriculture in BC (1981) – West Kootenay Locations

Location	Elevation (m)	GDD	FFD	P	PE	*P – PE (mm)	Thermal Class	Moisture Class	Improved rating	Unimproved rating
Columbia Gardens	433	2075	133	211	607	- 396	1aF	6A	1aF	6A
Crescent Valley	610	1662	96	247	572	- 325	1F	5A	1F	5A
Creston	593	1881	148	186	473	- 287	1aF	5A	1aF	5A
Fauquier	473	1775	149	239	479	- 240	1aGF	4A	1aGF	4A
Kaslo	588	1651	144	242	422	- 180	1aGF	3A	1aGF	3A
South Slocan	457	1960	140	243	598	- 355	1aF	6A	1aF	6A

Climate Capability Classifications for Agriculture in BC (1981)

Class	Freeze Free Days	GGD*	CMD (climate moisture deficit)
Class 1	90 – 119	1310 – 1504	< 40 mm
Class 2	75 – 89	1170 – 1309	40 – 115mm
Class 3	60 – 74	1030 – 1169	116 – 190 mm
1.a.	120 – 150	1505 - 1779	
1.b	> 150	1780 – 2059	
1.c	> 150	2060 – 2225	
1.d	> 150	> 2225	

SubClass Limitations	
A	Drought
E	Extreme min. temperatures
F	Min. temperatures
G	Insufficient heat units
Y	Excessive precipitation

RESOURCE - Climate Classifications from the: "Climate Capability Classification for Agriculture in BC, 1982"
*GGD – Growing Degree Days over 5 degrees C

Historical climate from the Soil Capability for Agriculture Maps

The data below is from the soil capability for agriculture maps. Climate variables were not consistent between maps and an x indicates no data.

Winter extreme minimum temperatures have been provided because extreme minimum temperatures hinder fruit tree production. Climate projections indicate warmer winter mean minimum temperatures and this may mean fewer instances of extreme winter lows.

Location	**Mean July temp** °C	**Winter extreme min.** °C	**FFD**
Creston	19.4	-27	130
Trail	21.1	-31	x
Kaslo	18.3	-24	145
Slocan	20.5	x	162

APPENDIX 3: Methodology for data analysis by soil Classification

Classification by weighted average

The land analysis portion of this project uses the weighted average of the Soil Capability for Agriculture Classification to quantify the 1 – 7 lands in the study area. The Soil Capability for Agriculture Maps usually have two soil capability Classes for each polygon (a single piece of Classified land). For example, a one hectare polygon with a Classification of $5^7 4^3$ means that 40% of the polygon is Class 5 and 30% of the polygon is Class 4. The weighted average is therefore 4.7. A Classification of $3^6 5^4$ means 30% of Class 6 and 5% Class 4 which averages to 3.8.

Classification by subclass (limitations)

The subclass limitation are only for the dominant capability class. For example, if the capability Class in the 1972 Soil Capability for Agriculture Maps is $5^7_M 4^3_T$, the dominant capability Class 5^7_M is used to show the limitation of 'M' (low moisture holding capacity).

If the dominant capability Class has two limitations such as 5^T_M, the T (Topography) is referred to as the 'primary limitation' and M (low moisture holding capacity) is referred to as the 'secondary limitation'.

Improved and unimproved ratings

The unimproved ratings are used for this report. The 'subclass' limitations are labeled on the map for each polygon to give an indication of the limiting factors that that need to be overcome to improve the capability Class.

APPENDIX 4: Overview of soil capability, ALR and land in use for agriculture

Soil Capability and % ALR by Regional District

Soil Capability by Regional District Area*									
RD Area	**1.0**	**1 - ALR**	**%**	**2.0**	**2- ALR**	**%**	**3.0**	**3- ALR**	**%**
Central Kootenay A							124.0	64.4	51.9
Central Kootenay B	750.8	400.9	53.4	2,805.6	2,608.1	93.0	2,207.1	1,593.5	72.2
Central Kootenay C	5,764.5	5,755.6	99.8	2,917.6	2,867.7	98.3	553.5	377.2	68.1
Central Kootenay D				2,969.0	2,534.9	85.4	2,236.3	1,717.0	76.8
Central Kootenay E							271.8	202.5	74.5
Central Kootenay G							1,139.4	867.1	76.1
Central Kootenay H	1.2						328.1	273.7	83.4
Central Kootenay J	112.5			261.5	26.9	10.3	376.8	303.9	80.7
Central Kootenay K	1,108.8	843.8	76.1	3,382.6	2,956.8	87.4	5,068.3	3,968.0	78.3
Kootenay Boundary B									
Kootenay Boundary C							267.5	184.4	

RD Area	**4.0**	**4 - ALR**	**%**	**5.0**	**5 - ALR**	**%**	**6.0**	**6 - ALR**	**%**
Central Kootenay A	1,667.6	364.5	21.9	7,471.3	16.6	0.2	78,923.3	47.4	0.1
Central Kootenay B	5,826.9	1,295.2	22.2	4,879.7	341.5	7.0	34,558.1	971.7	2.8
Central Kootenay C	2,021.0	1,350.3	66.8	3,416.0	860.1	25.2	13,849.7	888.0	6.4
Central Kootenay D	3,450.7	2,445.7	70.9	12,849.5	111.3	0.9	137,465.2	152.3	0.1
Central Kootenay E	2,722.8	829.1	30.4	5,650.7	39.4	0.7	33,946.8	6.9	0.0
Central Kootenay G	2,505.8	270.9	10.8	7,552.8	1,037.8	13.7	57,995.9	87.2	0.2
Central Kootenay H	7,751.2	3,466.7	44.7	10,936.7	517.4	4.7	114,221.7	110.6	0.1
Central Kootenay J	2,411.1	881.9	36.6	14,044.1	361.3	2.6	59,128.4	226.2	0.4
Central Kootenay K	18,348.7	12,677.6	69.1	32,318.8	1,116.1	3.5	152,022.9	683.4	0.4
Kootenay Boundary B	6,178.6	2,230.2	36.1	11,556.5	2,003.7	17.3	51,824.7	350.0	0.7
Kootenay Boundary C	636.3	467.5	73.5	2,492.3	319.9	12.8	31,434.6	175.5	0.6

RD Area	**7.0**	**7 - ALR**	**%**	**Total Ha ALR**
Central Kootenay A	81,911.5			492.9
Central Kootenay B	51,701.3	164.4	0.3	7,375.2
Central Kootenay C	44,944.5	11.8	0.0	12,110.6
Central Kootenay D	237,151.9	334.3	0.1	7,295.5
Central Kootenay E	78,982.9	46.7	0.1	1,124.6
Central Kootenay G	82,714.3	168.1	0.2	2,431.1
Central Kootenay H	141,273.9	59.2	0.0	4,427.6
Central Kootenay J	68,993.1	51.9	0.1	1,852.0
Central Kootenay K	223,110.3	558.4	0.3	22,804.0
Kootenay Boundary B	42,151.1	84.0	0.2	4,667.9
Kootenay Boundary C	18,143.2	9.2	0.1	1,156.5

APPENDIX 5: Subclass limitations for land in ALR

Moisture holding capacity is the most common primary limitation for lands Classified within the ALR with 34% having a moisture holding capacity limitation for agriculture. Irrigation can improve this soil Classification.

Topography is the second most limiting factor with 22%. This limitation cannot be overcome, however, topography may not a limiting factor to the cultivation of fruit trees or grapes.

The highest percent for the secondary limitations include stoniness and topography at 16.9% and 16.7%.

Primary Limitation for Agriculture – ALR		
Limitation	**Area_ha**	**% ALR**
<Null>	5,118.3	7.8
C	2,860.1	4.4
D	3,921.9	6.0
E	0.2	0.0
I	1,004.3	1.5
M	22,842.8	34.7
P	7,090.7	10.8
R	360.3	0.5
T	14,468.5	22.0
W	7,381.7	11.2
X	689.1	1.0
Study area (ALR)	65,737.8	100%

Legend: Capability SubClass	
C	Climate
D	Undesirable soil structure
E	Erosion damage
F	Fertility (low fertility)
I	Inundation by streams or lakes
M	Moisture holding capacity
N	Salinity
P	Stoniness
R	Depth to solid bedrock
T	Topography
W	Excess water
X	Cumulative minor adverse characteristics

Secondary Limitation for Agriculture - ALR		
Limitation	**Area_ha**	**% ALR**
<Null>	31,447.0	47.8
C	1,120.4	1.7
D	1,397.5	2.1
I	3,470.9	5.3
M	2,271.8	3.5
P	11,101.5	16.9
R	1,986.6	3.0
T	10,994.3	16.7
W	1,947.8	3.0
Study area (ALR)	65,737.8	100%

APPENDIX 6: Growing Requirements for Specific Crops

Varieties

A longer growing season, more growing degree days and warmer winter minimum temperatures may expand the range of crops that can be grown such as grapes, fruit varieties and annual crops such as melons. A short description is provided below for some crops that are popular amongst consumers and value added producers that may do well with a changing climate in this region.

Hops (perennial)

Hops requires long daylight hours, well-draining soil and lots of moisture. A minimum of 120 frost free days are needed for flowering. Direct sun-light and long day length (15 hours or more) is also needed. Hop production is therefore limited to the latitudes between 35 and 55 degrees, north or south to fulfil the lay length requirements. For optimal growth, hops also have specific chilling requirements with winter temperatures below 4.4 degree Celsius for 1 to 2 3 months (Sirrine, et al., 2010).

Hops can be grown in wetter climates as long as the season is long enough and bright enough (Kneen, ND). They prefer well-draining, deep, sandy loam soils and require a lot of water during the growing season.

Hops would likely grow on Class 3-4 soils and may also be suitable for Class 5 if soils are deep and well-draining and the topography and soil structure was not limiting.

Grapes (perennial)

Grapes grow best in direct sunlight with mild, dry spring conditions followed by long dry warm summers with little wind and a warm autumn followed by mild winters. A minimum of 850 grape Growing Degree Days (GDD) above 10^{o}C are needed to mature very early grape selections currently produced in British Columbia and more than 1400 are needed to mature late wine grape selections (Vielvoye, 2008). For reference, Creston's average is 1025 GDD above 10^{o}C based on a thirty year period (Farm West, 2014). Limitations in the West Kootenay Region historically have been low winter temperatures followed by a short frost free season and lower growing degree days.

Grapes are deep rooted plants and grow reasonably well on a range of soil types including soils with high percentage of coarse fragments (gravels and stones). Coarser textured soils warm up early and allow for ease of root penetration and oxygen but require more irrigation than finer textured soils (Vielvoye, 2008).

Grapes would therefore be suited for more marginal soils that are deep and well-draining including Class 4 and 5 with irrigation.

Quinoa (annual)

Quinoa is grown mainly in cool mountainous regions because it requires cool evenings and air temperatures below 32 - 35 degrees. Quinoa also requires short days for flowering (University of Wisconsin Extension, 1992). The short day lengths required for flowering may pose an issue in the in this region, however, there have been successes growing quinoa in Colorado at higher elevations (2,000m – 3,000m) with plants having a wide range of maturity in Colorado from 95 – 125 days (Johnson, 1985).

Quinoa is somewhat drought tolerant crop with a total water requirement of 25.4 - 38.0 cm during the cropping season on sandy-loam or loamy-sand soils (Alberta, Agriculture, Food and Rural Development, 2005).

In the Kootenay region, quinoa would likely be suited for areas at higher elevations with cooler temperatures. Because it's drought tolerant it may be a good crop for land that doesn't have access to irrigation.

Melons (annual)

Melons prefer hot, sunny locations with fertile, well drained soils. Melons are members of the cucurbit family, which includes pumpkins, zucchini, cucumbers, summer squash and winter squash and therefore have similar growth requirements.

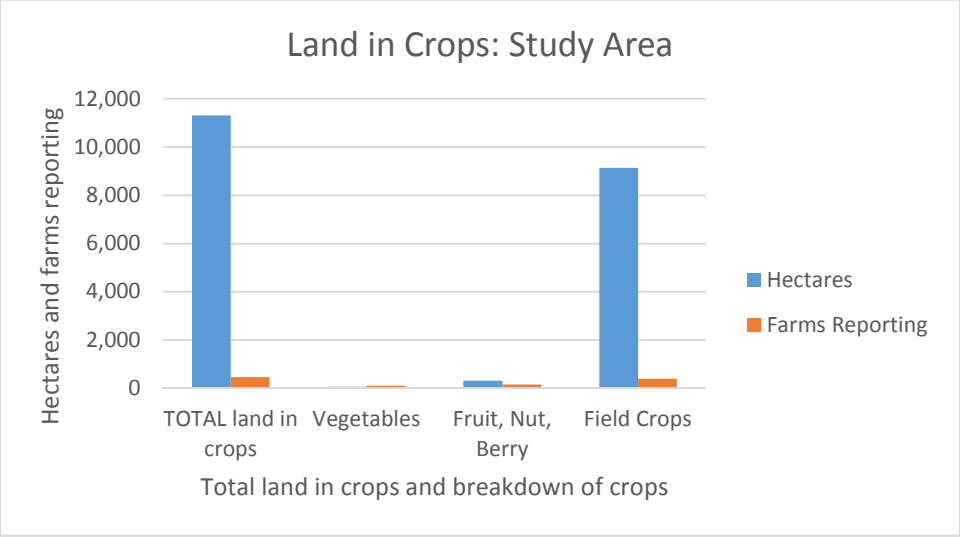
Melons including watermelons grow best in air temperatures ranging from 21 – 32^{o}C and where nighttime temperatures are above 10^{o}C. If temperatures exceed 32^{o}C for several days, flowers will drop without setting fruit. Watermelons require 65 to 90 frost-free days to reach harvest and will tolerate no frost (Albert, 2009).

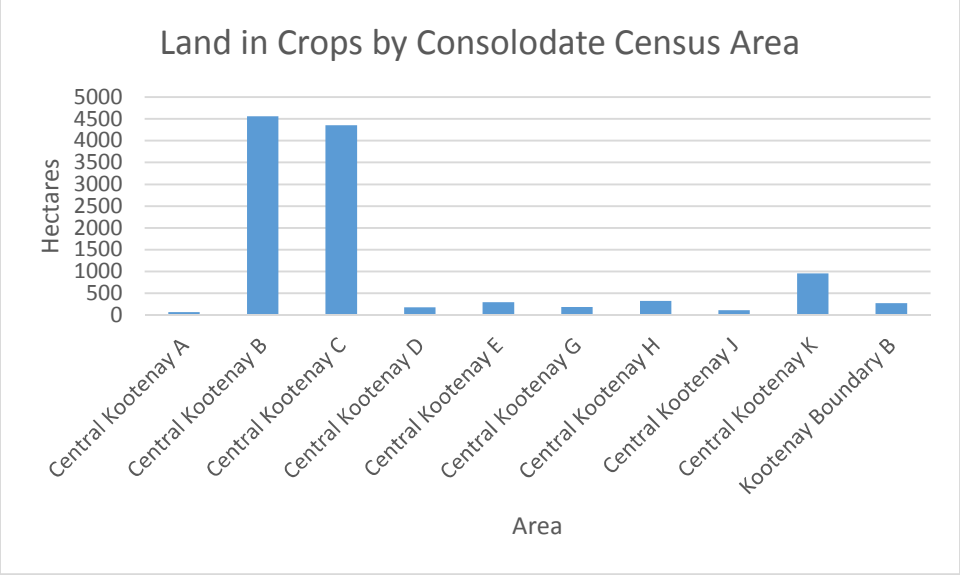
Melons grow best on well-drained, sandy loam soils with lots of nutrients and organic matter and require 1 – 2 inches of water per week (Foord, Karl and Jill MacKenzie, 2009). Melons and other tender squash plants are best suited for soil capability Class 1 – 3 or improved Class 4 where there is a long frost free period.

APPENDIX 7: Details of Crop Varieties

Overview of land in crops and crop varieties in the study area

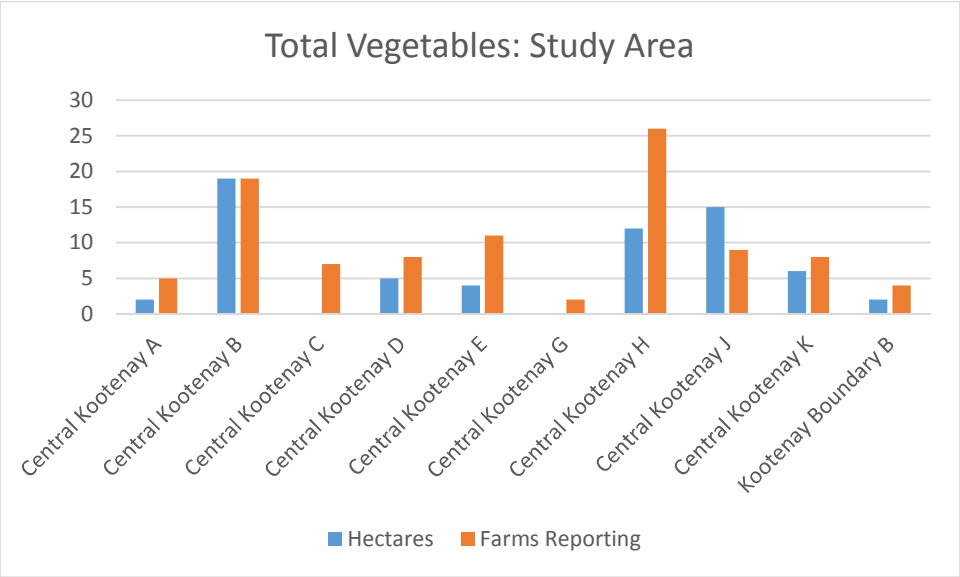
Crop	Total Hectares	Total Farms Reporting
Field Crops (alfalfa, potatoes, forage, wheat, barley, rye)	9,136	393
Fruit, nut and Berries	309	153
Vegetables	65	99



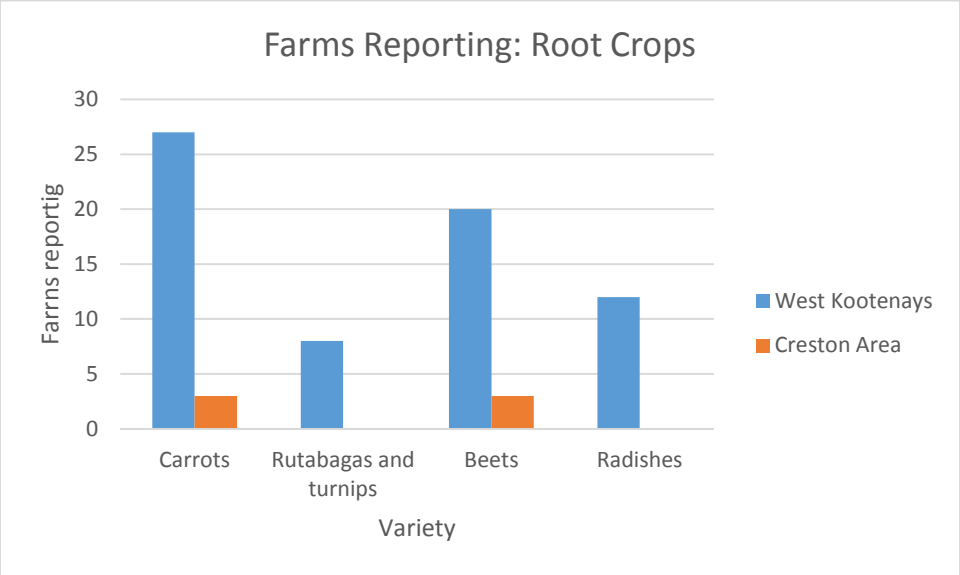


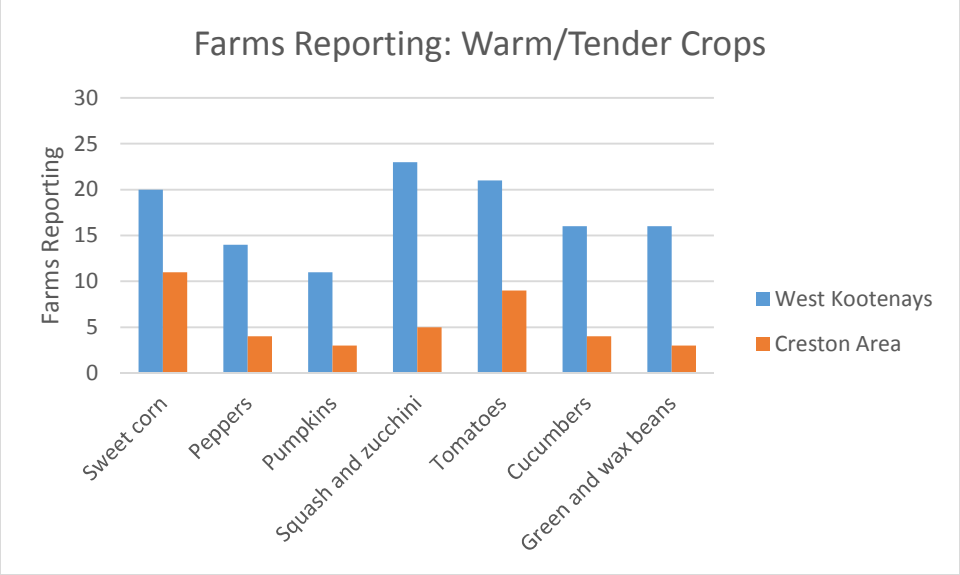
Vegetables

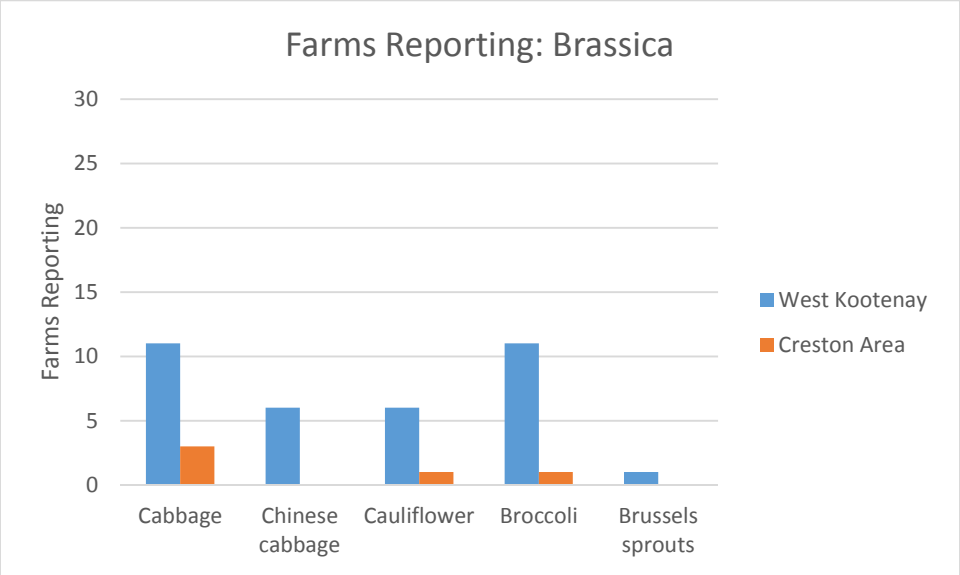
- Total Ha: 65
- Farms reporting vegetable production: 99

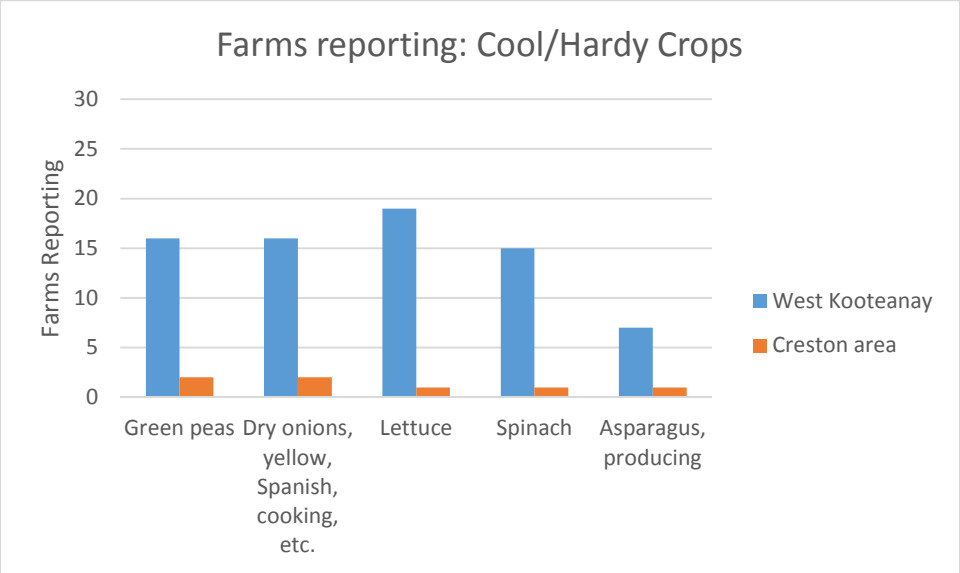


*excluding greenhouse vegetables



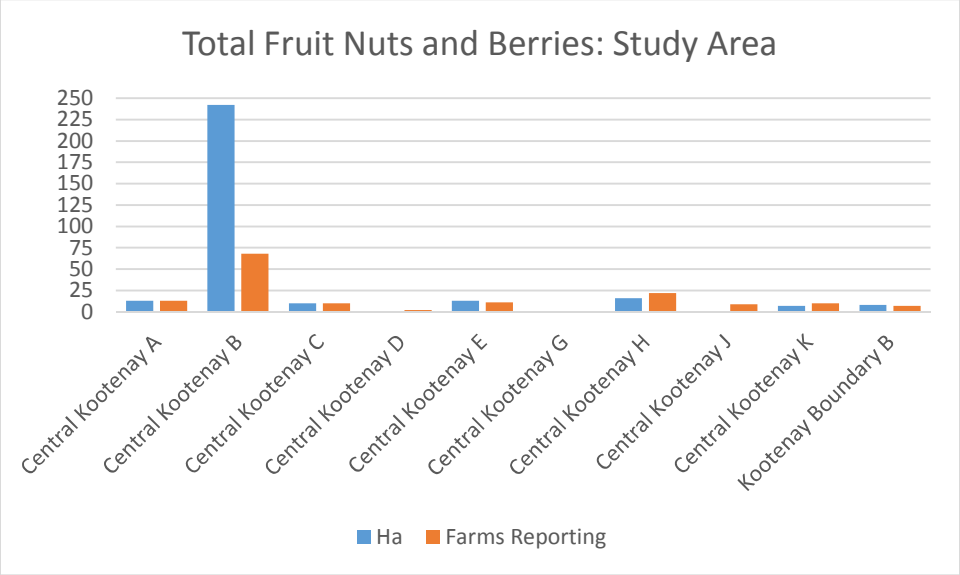

Farms Reporting: Warm/Tender Crops
Farms Reporting
30
25
20
15
10
5
0
Sweet corn
Peppers
Pumpkins
Squash and zucchini
Tomatoes
Cucumbers
Green and wax beans
West Kootenays
Creston Area

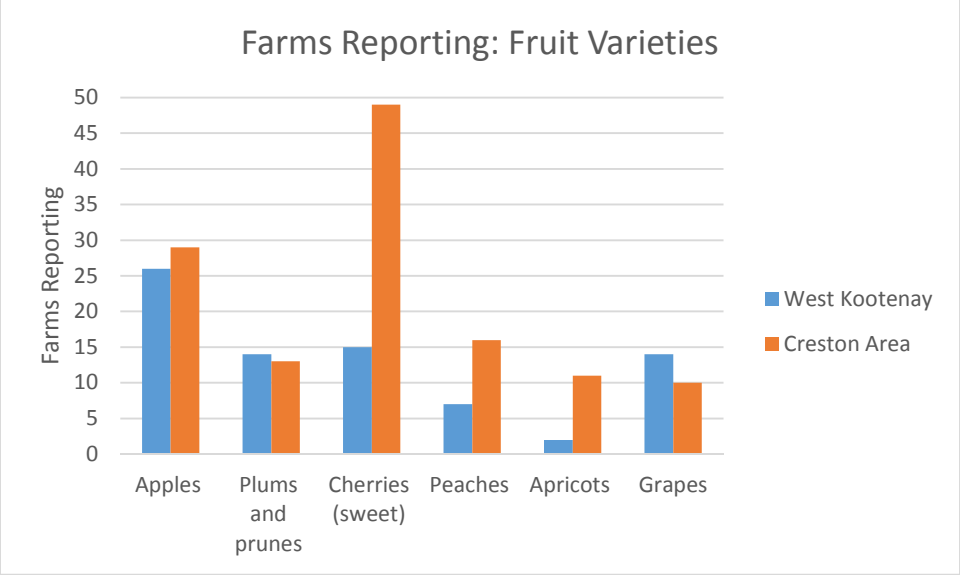

Farms Reporting: Brassica
Farms Reporting
30
25
20
15
10
5
0
Cabbage
Chinese cabbage
Cauliflower
Broccoli
Brussels sprouts
West Kootenay
Creston Area

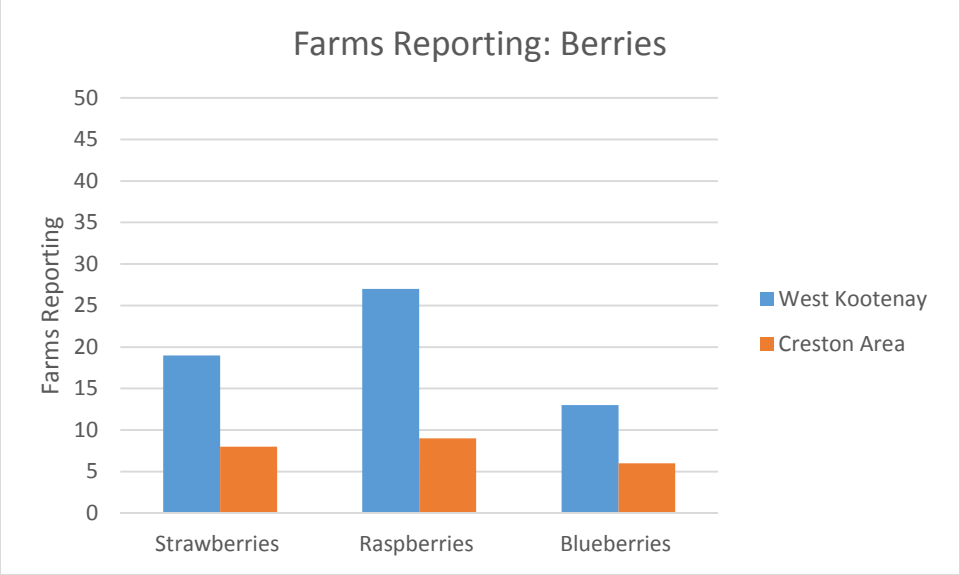

Farms reporting: Cool/Hardy Crops
Farms Reporting
30
25
20
15
10
5
0
Green peas
Dry onions, yellow, Spanish, cooking, etc.
Lettuce
Spinach
Asparagus, producing
West Kooteanay
Creston area

Fruit, Nut and Berries

- Total Ha: 309
- Farms reporting: 153

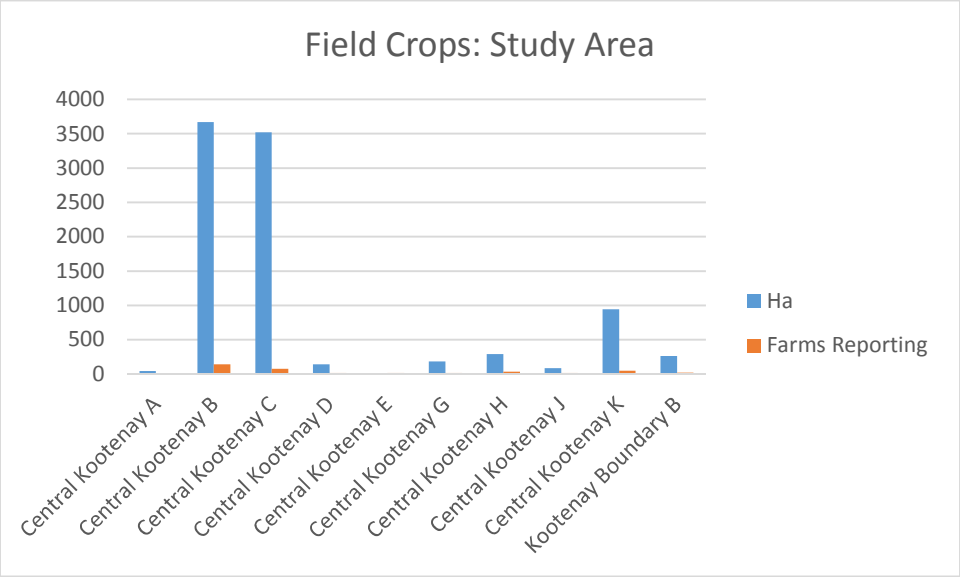


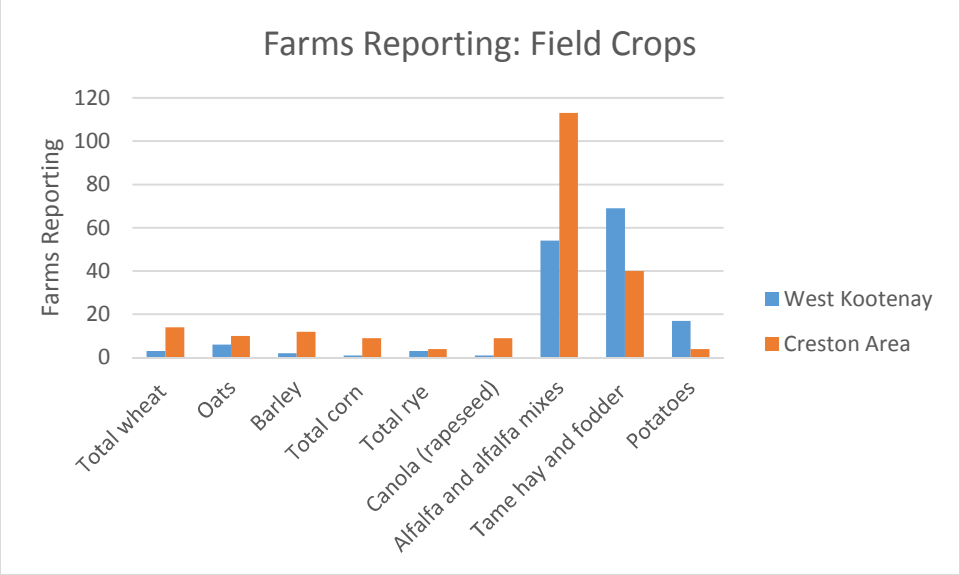


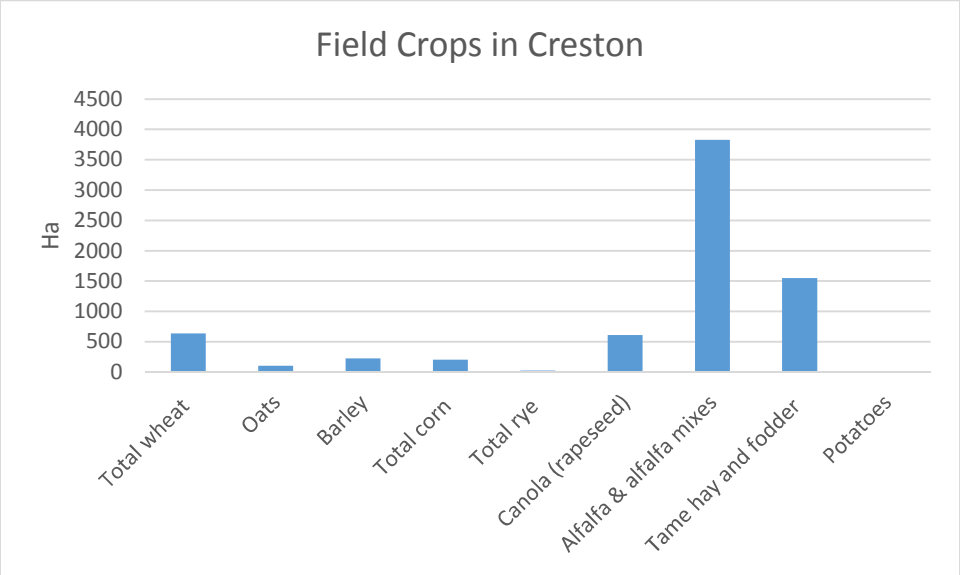


Field Crops

- Total hectares: 9,136
- Total farms reporting: 393





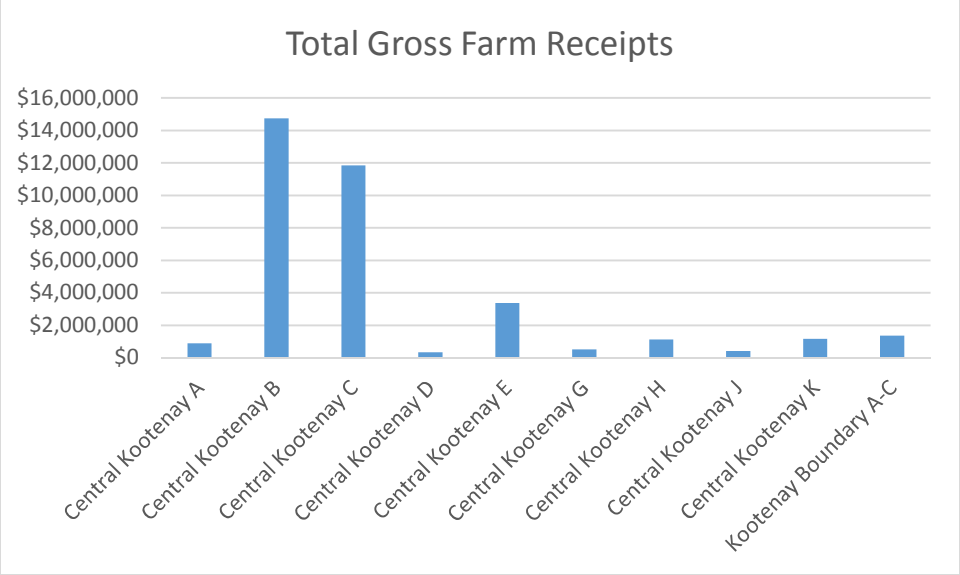


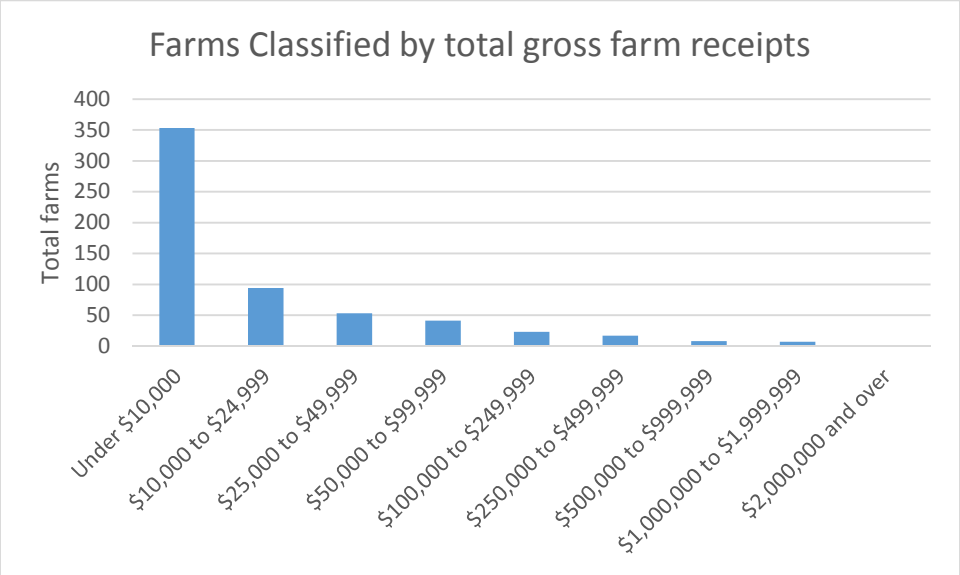
Total Gross Farm Receipts

Total farms reporting: 597

Total gross farm receipts: $35,713,542

- Farms under $25,000: 447
- Farms $25,000 - $100,000: 94
- Farms over $100,000: 56


Total Gross Farm Receipts
$16,000,000
$14,000,000
$12,000,000
$10,000,000
$8,000,000
$6,000,000
$4,000,000
$2,000,000
$0
Central Kootenay A
Central Kootenay B
Central Kootenay C
Central Kootenay D
Central Kootenay E
Central Kootenay G
Central Kootenay H
Central Kootenay J
Central Kootenay K
Kootenay Boundary A-C


Farms Classified by total gross farm receipts
Total farms
400
350
300
250
200
150
100
50
0
Under $10,000
$10,000 to $24,999
$25,000 to $49,999
$50,000 to $99,999
$100,000 to $249,999
$250,000 to $499,999
$500,000 to $999,999
$1,000,000 to $1,999,999
$2,000,000 and over