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ASSESSMENT OF SOIL HEALTH IN ALBERTA AND MANITOBA

Author

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Soil Health

Campbell et al. 1997 found that the elimination of fallow had the greatest impact on total organic C, N, and microbial biomass. Lupwayi et al. 2009, Liebig et al. 2006, and Lupwayi et al. 1999 show significantly higher soil microbial biomass and diversity (Lupwayi et al., 1998) relative to conventional tillage. The difference between the tillage systems being in the top few centimetres of soil which has more crop residue and moisture creating a suitable microbial environment. Clapperton et al. 1997 report significant differences in earthworm populations between zero tillage and conventional tillage in a 25-year wheat –fallow rotation. The difference in soil health between zero tillage and conventional tillage should be reflected in greater N and P availability which would present itself in higher yields and quality (protein).

Nutrient Runoff (Wind, Water and Tillage Erosion)

Erosion due to wind and water is a function of crop residue, soil health and weather events. Tillage affects the amount of crop residue that is available to limit erosion either from high wind, snowpack melt and high rainfall events. Tillage also affects the erodibility of the soil by increasing the amount of aggregates that are susceptible to erosion. Also, the permeability of the soil affects the amount of runoff from a field. Drought affects the amount of crop residue and tillage of a dry soil creates higher amounts of small aggregates. Elimination of fallow plays a major role in reducing erosion. Chem fallow and Chem/Till fallow are less prone to erosion than tillage fallow.

Tillage erosion is a function of the number of tillage passes, type of implement and terrain. Reduced tillage on hilly or rolling landscapes limits the amount of soil that moves from the hilltops. Typically, the area affected is from 20% to 30% (Govers et al. 1999).

The amount of residue needed to control wind erosion given the soil type and water erosion by slope is presented in Table K. The crop residue for each crop in each crop district is calculated from the crop yield and by the reduction in residue due to tillage operations. If the crop residue falls below the acceptable levels required to mitigate erosion, then those hectares are susceptible to erosion. The model is used to calculate the area susceptible to wind erosion for the fall and spring periods. The assumption used is that conventional tillage has a post harvest and a spring pre-seed

tillage operations. Minimum tillage would have a banding operation either post harvest or pre-seed. Area in summer fallow by crop district is allocated to tillage, tillage/chemical and chemical practices for summer fallow management from Statistics Canada Agricultural Census data.

TABLE K: CROP RESIDUE LEVELS TO MITIGATE EROSION (TONNES PER HA)

	Conventional Tillage			Minimum Tillage			N-Till		
	Cereal	Oilseed	Pulse	Cereal	Oilseed	Pulse	Cereal	Oilseed	Pulse
Sandy	1.96	3.05	3.63	1.23	1.49	2.95	0.13	0.20	0.12
Loam	1.00	1.60	1.82	0.64	0.66	1.45	0.13	0.20	0.12
Clay Loam	1.05	1.67	1.91	0.73	0.71	1.52	0.13	0.20	0.12
Heavy	1.31	2.04	2.38	0.84	0.95	1.94	0.13	0.20	0.12

Source: Adapted from McConkey and Panchuk, 2009.

The estimate of the area at risk of erosion is presented in Figures 1 and 2 for Alberta and Manitoba, respectively. With the adoption of minimum and zero tillage seeding systems along with the reduction in summer fallow area, the trend in hectares at risk of erosion has fallen over the period 1985- 2016. The area at risk of erosion is higher in the spring relative to the fall period, however as conventional tillage area declines the difference is narrowing. Drought has a major impact on the amount of crop residue left after harvest which is evident for the 1987-88, and 2001-02 droughts in Alberta and Manitoba. Increased tillage as a result of flooding in Manitoba resulted in higher risk of erosion in 2005, 2010 and 2014.

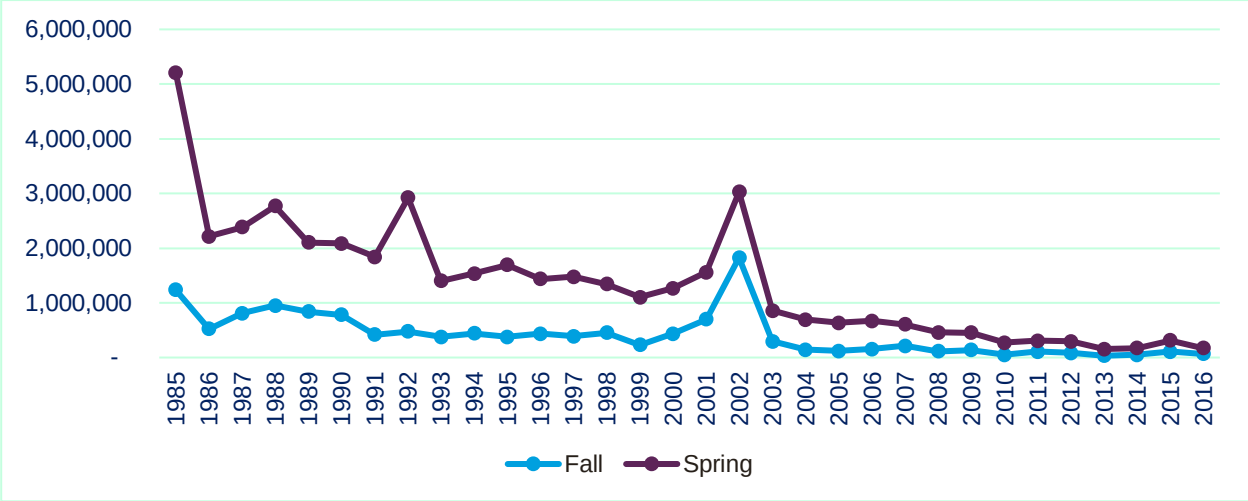

Figure 1: Alberta Fall and Spring Area (ha) at Risk of Erosion

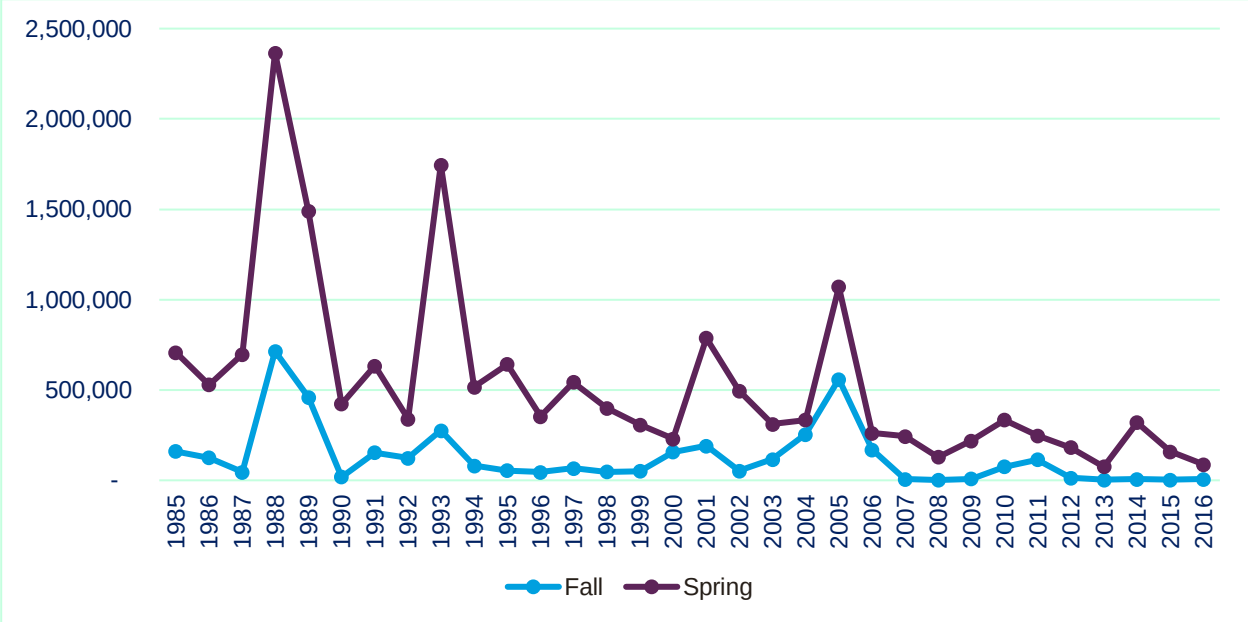

Figure 2: Manitoba Fall and Spring Area (ha) at Risk of Erosion

The amount of area at risk of erosion by soil zone for Alberta is presented in Figure 3 and 4, for Fall and Spring, respectively. Given that the Brown and Dark Brown soils are in general lighter texture and yields are generally lower compared to Black and Gray soils, the levels of soils at risk are higher on a yearly basis. The trend is for lower area at risk of erosion at the soil zone level as summer fallow is reduced.

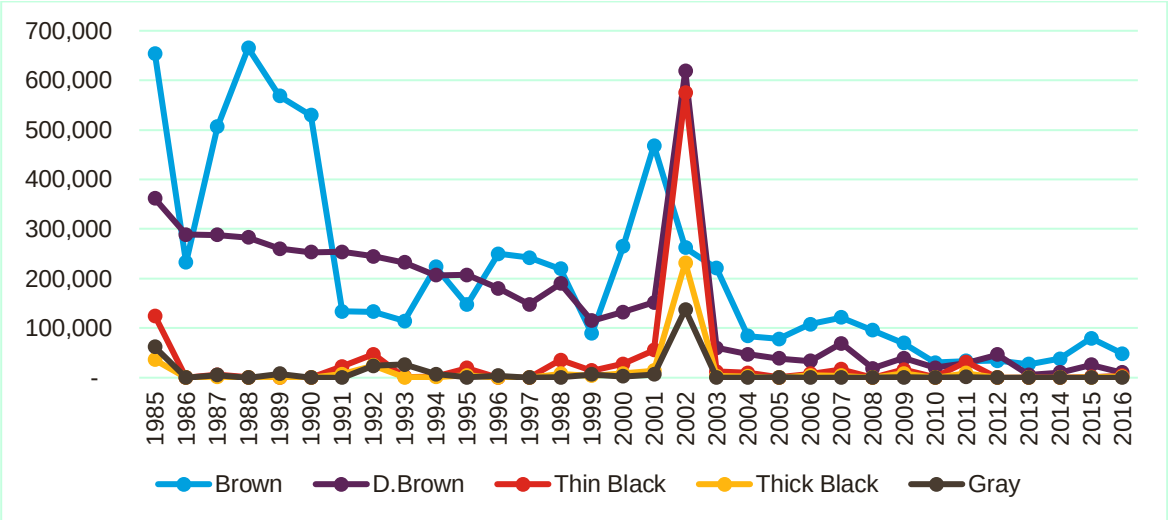

Figure 3: Alberta Fall Area(ha) at Risk of Erosion by Soil Zone

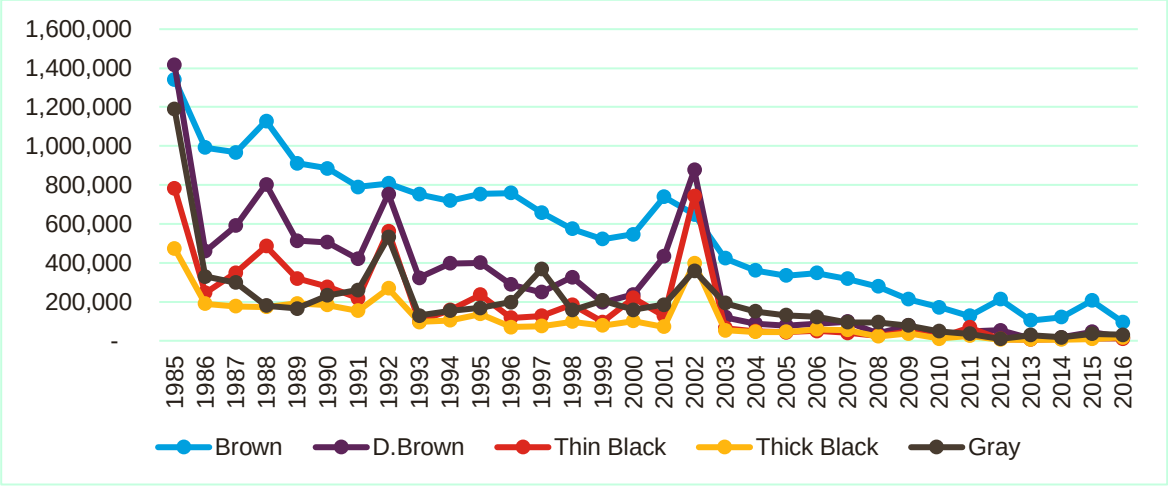

Figure 4: Alberta Spring Area(ha) at Risk of Erosion by Soil Zone

The amount of area at risk of erosion by crop district for Manitoba is presented in Figure 5 and 6, for Fall and Spring, respectively. Drought, especially in the dryer southwest (crop district 1) and flooding is the main causes of increased risk of erosion.

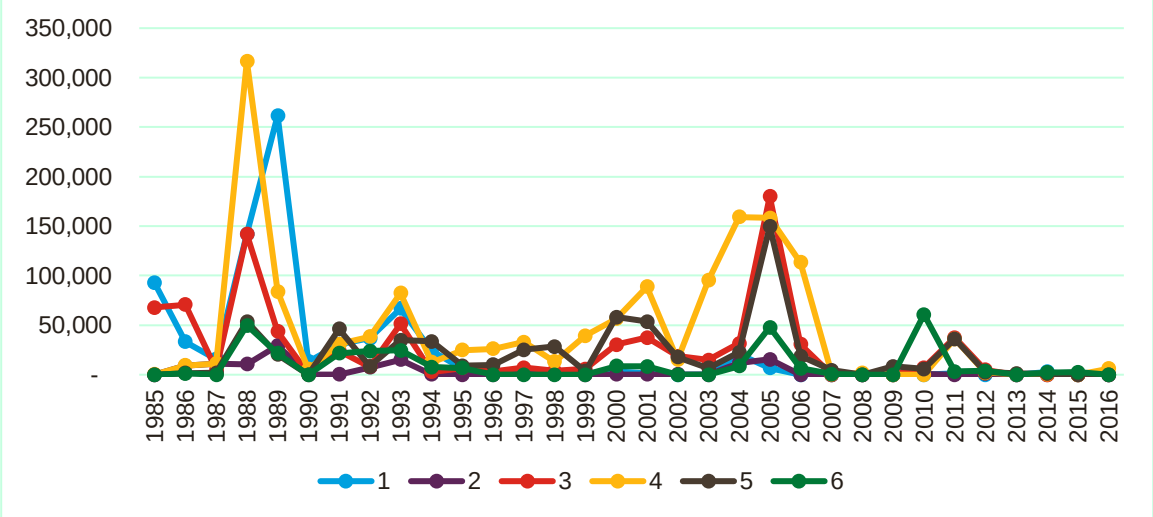

Figure W: Manitoba Fall Area(ha) at Risk of Erosion by Soil Zone

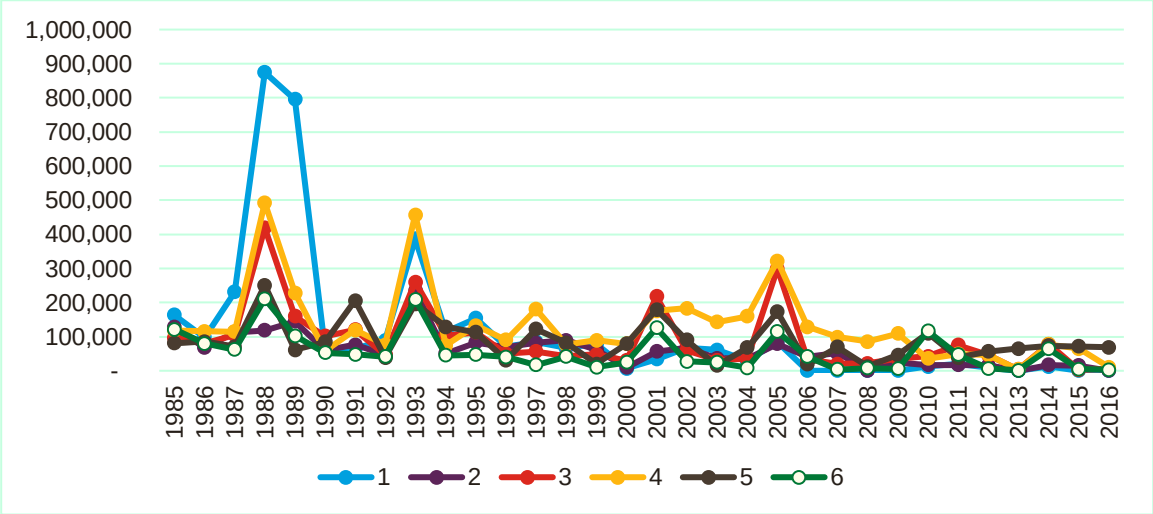

Figure Q: Manitoba Spring Area(ha) at Risk of Erosion by Soil Zone

Conclusion

Since, the adoption of conservation tillage practices and the concurrent decline in summer fallow area the amount of land that is at risk for erosion on a yearly basis in western Canada has declined at the provincial and soil/crop district level. Drought and flooding can still expose land to the risk of soil erosion through less crop residue or increased tillage. However, in terms of soil health, less erosion combined with improved soil structure and microbial environment has improved the soil. The improvement in soil health have been greater in Alberta relative to Manitoba because of the low level of zero tillage adoption rate in Manitoba.

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