Examining Carbon Credits as an income Source for Peterborough County Farmers

Includes:

Final Report, The expected carbon sequestered (CO_2e) in tonnes by management type, per year per hectare.2 , Calculations for Figure 5&6, Table 3 Calculations

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Examining Carbon Credits as an Income Source for Peterborough County Farmers

Final Report

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Executive Summary

Improved carbon management is vital if Canada is to mitigate climate change and reach net zero emissions by 2050[5]. Reducing greenhouse gas emissions and increasing carbon sequestration will be important if Canada is to accomplish net zero emissions by 2050. The carbon market is a key part of Canada's plan to mitigate climate change. The carbon market directs polluters to purchase registered carbon credits, which each represent 1 tonne of carbon (CO2e) that has been removed from the atmosphere. A carbon credit can be created through sequestration or through emission reductions, and both methods must be verified by a third party.

Agricultural soils can sequester carbon.[1] Peterborough County farmers have the opportunity to mitigate climate change and be financially compensated by entering the carbon market (Figure 5). Farmers of Peterborough County can enter the carbon market as an amalgamated group, which is expected to reduce barriers and increase farmer enrollment. Entering the carbon market would provide additional income for the farmers of Peterborough County and could generate millions in income for the region by 2030.

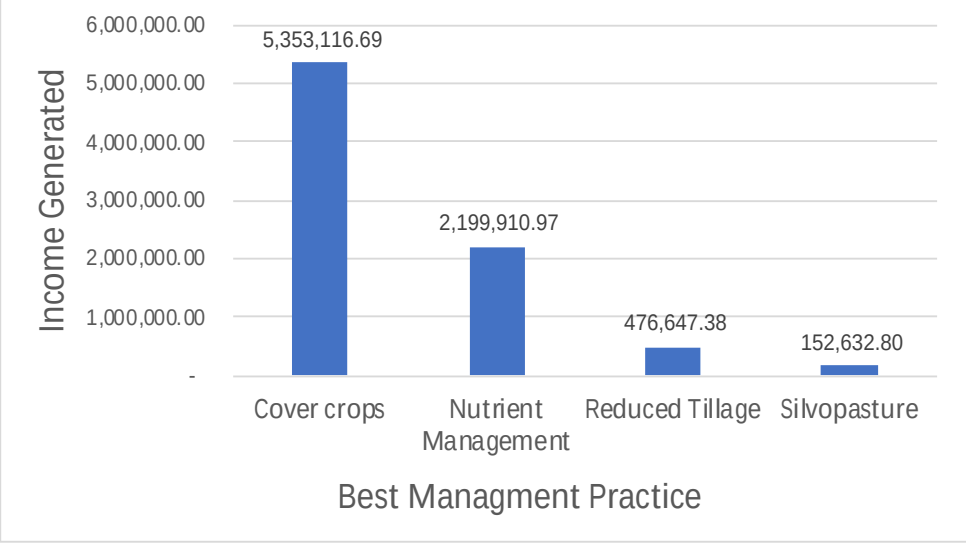

Figure 5: Potential income generated in 2030 from a subset of many best management practices that were identified to have high potential, with a 50% adoption rate for Peterborough County.

Entering the carbon market would encourage sustainable agricultural practices, which could increase soil quality, including fertility, water holding capacity and overall productivity. Additionally, there is the unique opportunity to situate Peterborough County as a leader in this area, as no other Canadian region is participating in the carbon market as a collective. Peterborough County could be a national leader, stimulating regional growth and helping to mitigate climate change while generating income for local farmers. Furthermore, the required data that is collected could be useful for research or marketing purposes, which could encourage growth. Entering the carbon market encourages sustainable agricultural practices and helps to fund the transition from conventional agriculture to sustainable agriculture.

Definitions

CO2e: Carbon Dioxide equivalent.

(Biological) **Carbon Sequestration**: the process of removing carbon dioxide from the atmosphere and storing the carbon in vegetation, soils, woody products and aquatic environments.

Cover Cropping: Planting crops that will not be harvested for market, when the ‘cash crop’ (crop destined for market) is not growing.

Reduced Tillage: Reducing the amount of tillage (working of the soil or soil disturbance) in comparison to conventional agricultural practices.

Nutrient Management: Improved nutrient management, reducing the greenhouse gas emissions from Nitrogen fertilizer[2].

Silvopasture: Integrating trees into pastureland where livestock graze.

Background

Climate change refers to long-term change in temperature and weather patterns[3]. Human activity has had a drastic effect on the environment, which has expedited climatic change, which will have severe consequences including droughts, flooding and catastrophic storms[4]. Globally, there is significant concern regarding the threats of climate change, resulting in many nations producing plans to mitigate climate change and its effects[4].

The Government of Canada has set in place the ambitious goal of net zero emissions by 2050[5]. Canada's plan includes putting a price on pollution, which is a proven method to reduce greenhouse gas emissions[5]. To meet the goals, set out in the Paris Agreement, the government of Canada has placed a minimum price on emissions, currently $65 per tonne of carbon emissions, which is set to incrementally increase annually until 2030[6]. As a result of the Canadian climate plan, polluters are financially responsible for excess emissions, as defined by the federal government[6]. Polluters can purchase registered offset credits, with the minimum price set by the Canadian government, to comply with federal regulations or voluntary climate commitments[6].

The reciprocal nature of offset credits ensures that polluters are obligated to incur the costs of pollution, while individuals who remove or reduce greenhouse gas emissions are compensated for their efforts. One offset credit represents one tonne of verified carbon (CO2e) reductions by actions that reduce emissions or remove greenhouse gases from the atmosphere[6]. One method of removing greenhouse gases from the atmosphere is biological carbon sequestration, which is the natural ability of plants and ecosystems to store carbon[7]. Carbon can be sequestered in agricultural soils, which presents a unique opportunity for farmers to participate in the offset credit market[1].

Carbon sequestration is a natural part of the carbon cycle (Figure 1). Atmospheric carbon dioxide is captured by a plant leaf and is stored within plant cells[3]. A portion of captured carbon dioxide is respirated back into the atmosphere by plants[3]. The rest of the captured carbon is retained by plants while alive or dead but can be consumed by other organisms[3]. Once an organism dies, a decomposition process starts, where microbes consume the remains, and the carbon is transferred into the soil, becoming soil organic matter. Soil organic matter is sequestered carbon, which does not contribute to climate change.

Farmers can adopt practices that increase soil organic matter, therefore sequestering more carbon. Practices such as reduced tillage, improved nutrient management, cover cropping or implementing silvopasture increase rates of soil organic matter creation and carbon sequestration[2]. These practices can be used in Peterborough County to increase soil carbon and provide additional income for farmers upon entrance to the carbon market.

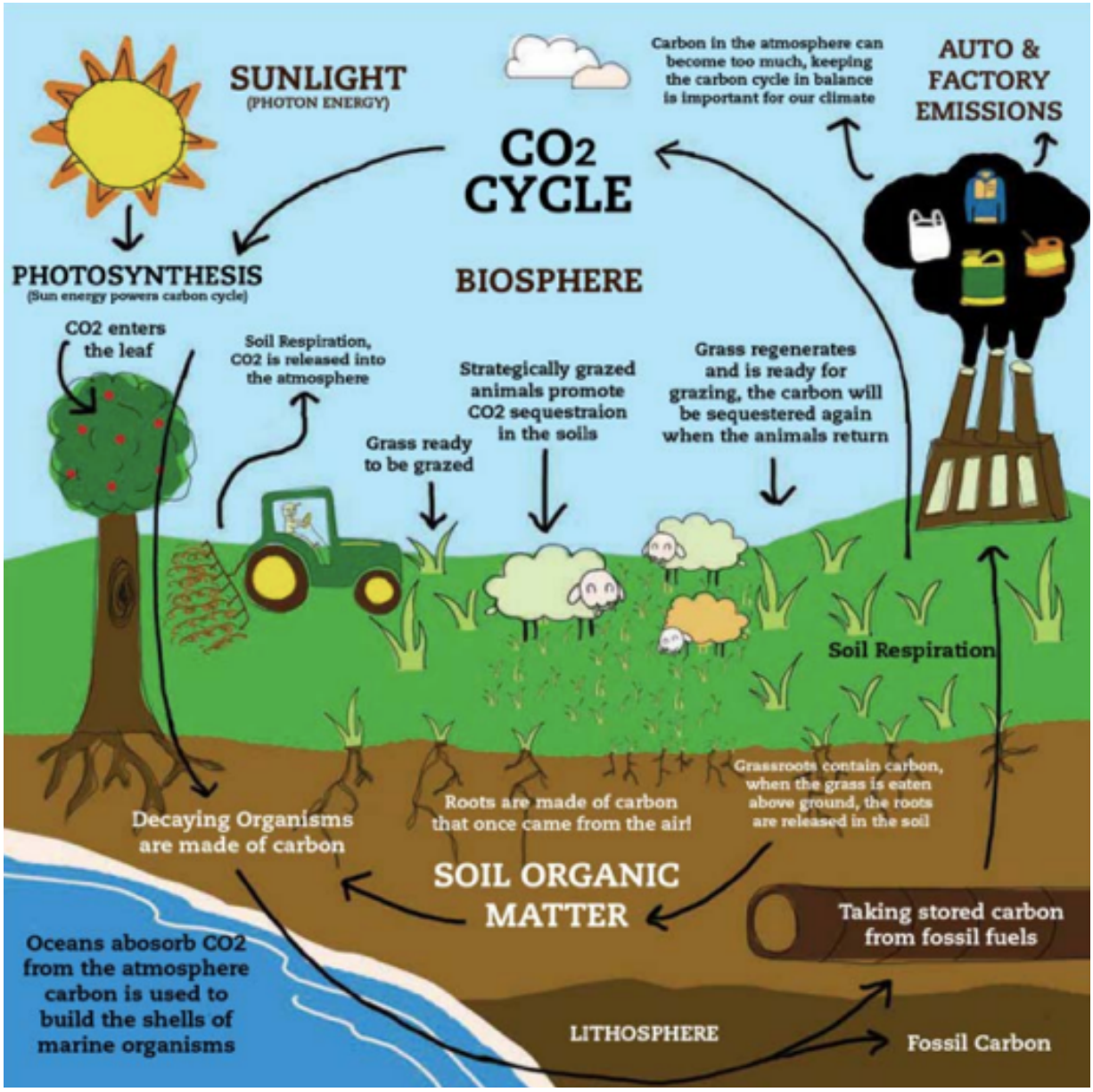

Figure 1: The Carbon Cycle.[8]
Figure Credit: Carbon Cycle.org website Access date: April 7th 2023

Entering the Carbon Market

Agricultural practices, such as reduced tillage, cover cropping, and silvopasture increase carbon sequestration and are known to improve soil quality[2]. These improvements can increase the productivity of the landscape, farm revenue, and can reduce dependence on agricultural inputs, such as synthetic fertilizers. Entering the carbon market encourages sustainable agricultural practices and helps to fund the transition from conventional agriculture to sustainable agriculture.

Entering the carbon market is expected to take multiple years (Figure 2). The next step is surveying the farmers of Peterborough County to gauge interest in entering the carbon market. Baseline soil carbon sampling should be conducted in Phase 2, or as soon as possible, because any increases in soil carbon will be eligible on the carbon market. Interested farmers will be able to sell all carbon sequestered between the sample date and market entrance, projected in 2026. The preparatory phase will include large amounts of bureaucracy, administrative, and organizational efforts to prepare for official market entrance.

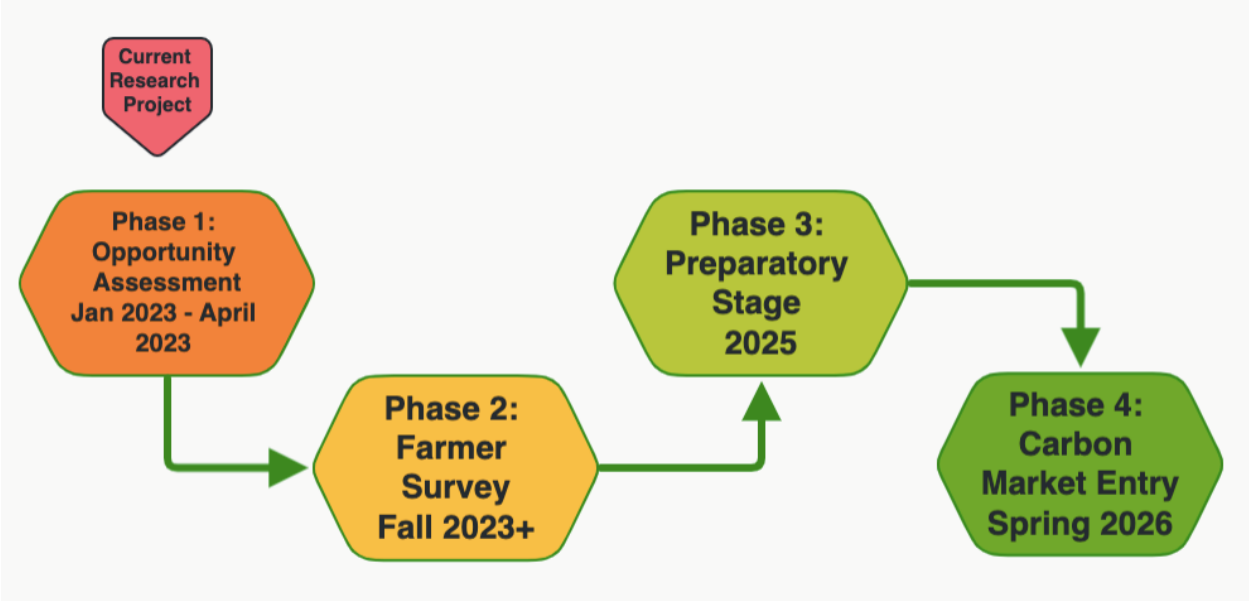

Figure 2: Timeline for carbon market entrance for Peterborough County.

A unique benefit of entering the carbon market for Peterborough County is the attention that will be garnered. Currently, it appears no other Canadian counties have entered the carbon market as a collective. Throughout my research, I was unable to find any precedence of another Canadian county entering the carbon market as an aggregate. Fortunately, under *Canadian Greenhouse Gas Offset Credit System Regulations*, a federal policy allows for aggregates to participate in the carbon market, which would apply to Peterborough County[9]. Based on extensive research, it is anticipated that Peterborough County will be the initial amalgamated group to participate in the carbon market.

The data that is collected for the carbon market will be of significance, as it is expected other counties will attempt to replicate the work of Peterborough County. In addition, the data that is collected may be useful for research or marketing purposes. The combination of attention and relevant data could prove to be incredibly fruitful for Peterborough County.

Entering the carbon market as an amalgamated group would allow for increased market power and create an employment position. It is critical that a paid position be created if Peterborough County wishes to enter the carbon market. After conducting research, it is apparent that entering the carbon market requires a significant amount of labour and time, which many local farmers do not possess. The time required to prepare paperwork, and coordinate with both the soil testing company and the verification body is expected to be impractical for farmers who are notoriously busy. Therefore, the expected responsibilities of the prospective employee include account management, ensuring adherence to current policy guidelines, and relations with the verification body, the soil testing company, and Peterborough County farmers. The creation of a paid position is expected to streamline the process, increase efficiency, and alleviate farmer time constraints.

Farmer enrollment is expected to increase because the creation of an employment position lowers the individual time investment required to join the carbon market. Further, entering the carbon market as an induvial farm, especially a small- to medium-sized farm, is likely, not feasible due to the low return on investment on a small number of hectares. The baseline administration work for entrance into the carbon market is expected to outweigh any financial gain by a small farm in Peterborough County. The creation of an employed position is likely to increase farmer enrollment by reducing barriers for Peterborough County farmers.

A key aspect of Peterborough County entering the carbon market is sourcing a verification body. This process should be started as soon as possible, directly after Phase 2, due to the expected duration, and importance for planning purposes. Verification bodies are companies that confirm the accuracy of assigned carbon credits, perform site visits, and ensure adherence to *Canadian Greenhouse Gas Offset Credit System Regulations*[9]. Verification bodies are required for the sale of carbon credits on the carbon market[9].

Preliminary assessment of potential income generated through the carbon market

The carbon offset credit market is a promising potential income source for farmers in Peterborough County. This potential income source could help to alleviate the pressures felt by farmers, as the farm income crisis continues[10]. For example, if half of all pasturelands in Peterborough County adopted silvopasture practices, which involve grazing livestock in treed pastures, $152,000 in income could be realized in the year of 2030 (Figure 3). In addition to the financial gain, benefits such as improved soil health, management practices and an accumulating abundance of useful soil data are likely to be experienced.

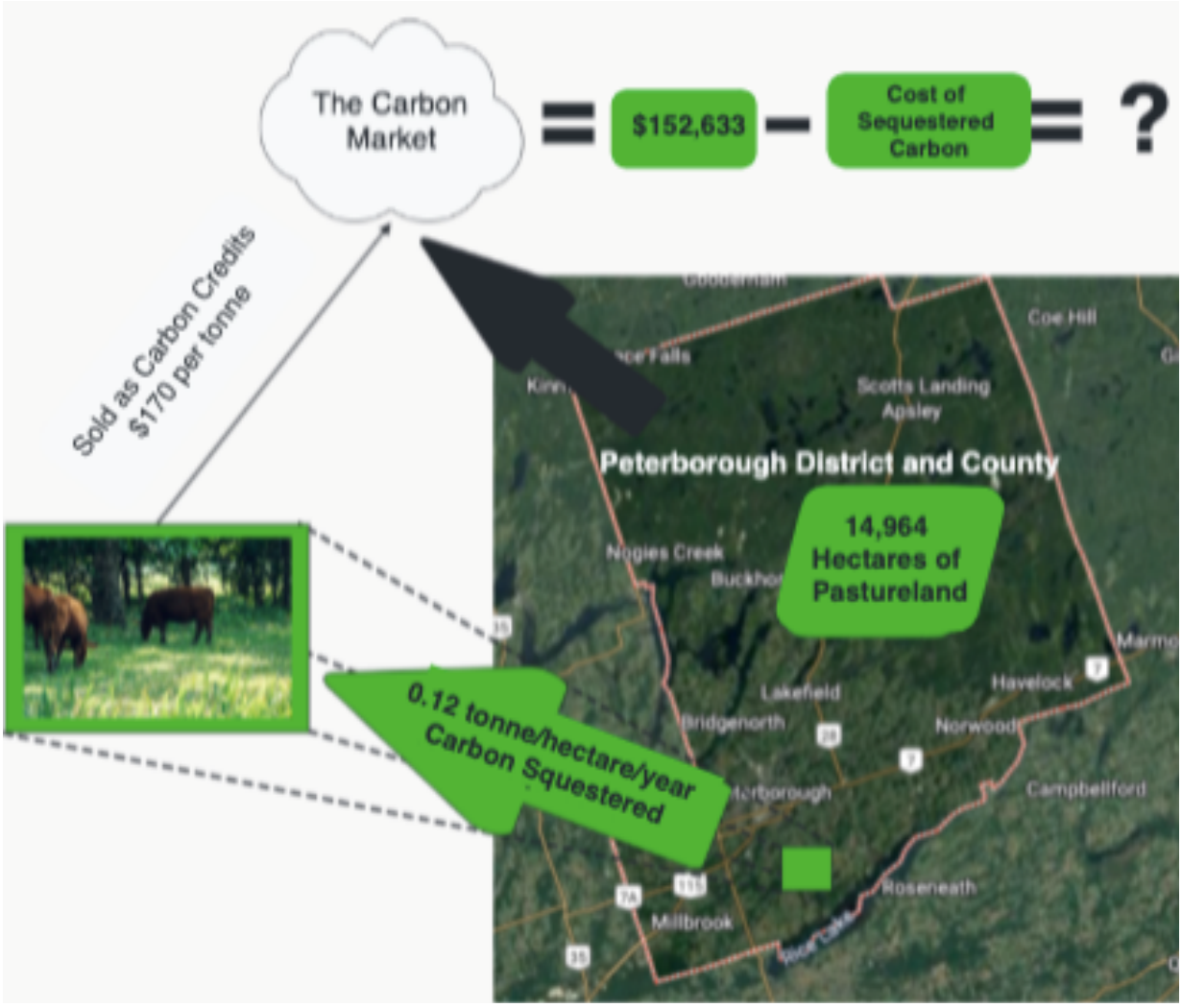

Figure 3: 2030 income with a 50% adoption rate of silvopasture on all pasture lands (both tame and natural land).

Figure 3 Methods

There are currently 14,964 hectares of pastureland in Peterborough County[11]. An adoption rate of 50% is calculated below for the County of Peterborough.

$$14{,}964ha\ x\ .05 = 7482\ ha$$

50% of Peterborough County pastureland multiplied by the anticipated carbon sequestration (Table 4) per year. [2]

$$7482ha\ x\ 0.12tCO2e/yr\ = 897.84tCO2e/yr$$

The anticipated carbon sequestration multiplied by the value of a carbon credit in 2030.[6]

$$897.84tCO2e/yr\ x\ \$170\ = \$152{,}633$$

It can be expected that $152,633 will be generated by Peterborough County farmers if 50% of pastureland is enrolled in the carbon market and implementing silvopasture. Figures 5 (2023) and 6 (2030) show the respective potential incomes generated by other best management practices at a 50% adoption rate in Peterborough County.

There is a considerable amount of money to be generated if Peterborough County enters the market, but by 2030 there will be a considerably higher potential (Table 1). This is due to the large price increases in the cost of carbon pollution in Canada, currently $65, which is increasing by a rate of $15 per year, until 2030, when the cost is $170 (Table 2;Government of Canada, 2021). The rapid increase in value for carbon credits is encouraging, as it indicates significant market growth in the coming years.

Table 1: The potential income generated if 50% of the total hectares in Peterborough County utilize the above management strategy and enter the carbon market, selling the annually sequestered carbon[11].

	Crop Land – Cover Crops	Crop Land – Nutrient Management	Crop Land – Reduced Tillage	Pastureland – Silvopasture
Hectares	43,136ha	43,136ha	43,136ha	14,964ha
Carbon Sequestered in tonnes (CO2e)	31,488.92t	12,940.65t	2,803.81t	897.84t
Income in 2023	$2,046,780	$841,142	$182,248	$58,360
Income in 2030	$5,353,117	$2,199,911	$476,647	$152,633

Table 2: Canadian approach to carbon pollution pricing, 2023-2030. The value is the minimum price of a carbon credit[6].

Year	2023	2024	2025	2026	2027	2028	2029	2030
Minimum Carbon Pollution Price ($ CAD/tonne CO2e)	$65	$80	$95	$110	$125	$140	$155	$170

Cropland is the most common land use type in Peterborough County (Figure 4). Therefore, recruiting cropland farmers is of the utmost importance, as it will have the greatest impact. For example, implementing cover cropping in 50% of Peterborough County by 2030, could yield over 5.3 million dollars (Table 1) and sequester 31,488.92 tonnes of carbon (CO2e) (Table 1).

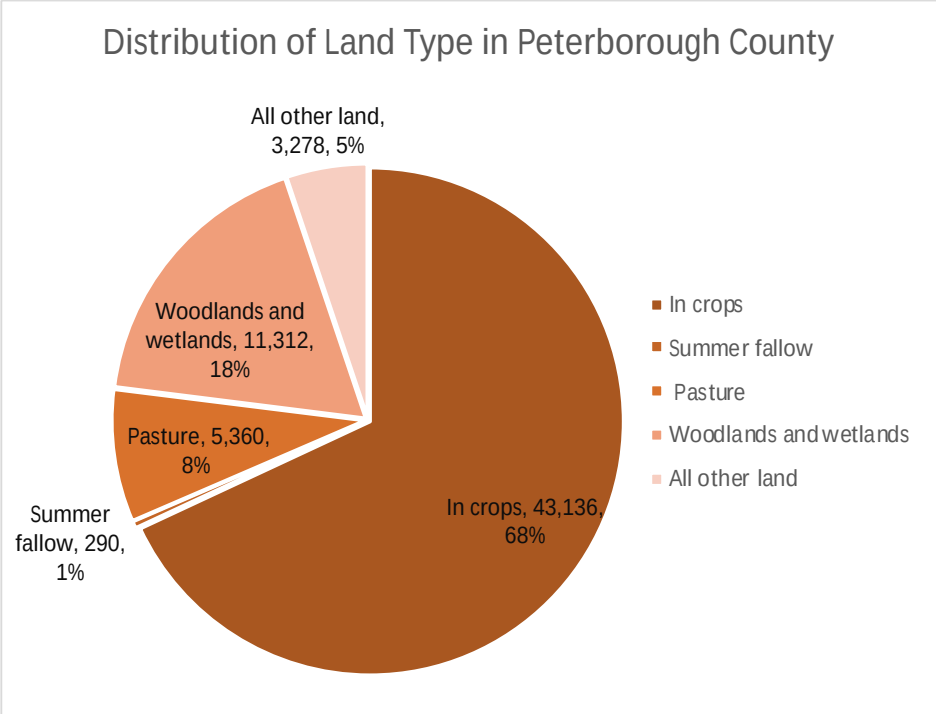

Figure 4: Proportion of types of agricultural land use in Peterborough County[11].

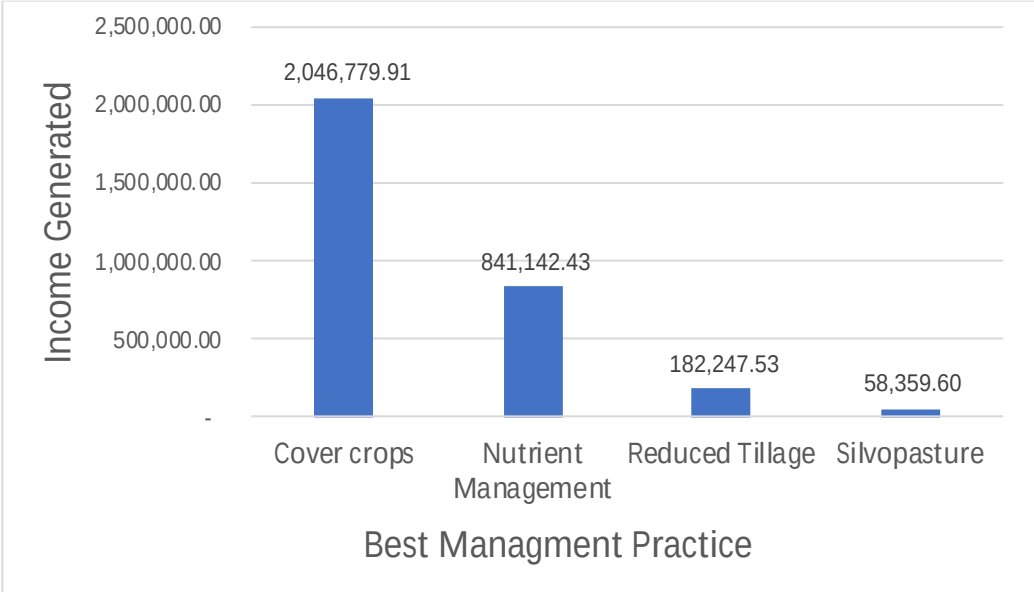

Figure 5: Potential income generated in 2023 from a subset of many best management practices that were identified to have high potential with a 50% adoption rate for Peterborough County with a $65 value of a carbon credit. Please see Appendix B for calculations.

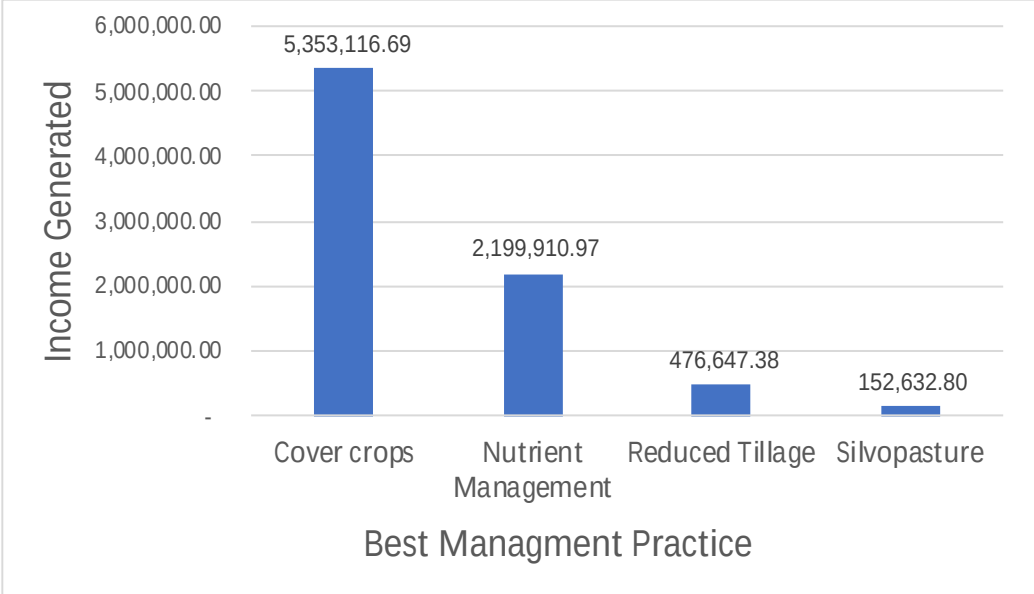

Figure 4: The potential income generated in 2030 from a group of best management practices selected for high potential, when the value of a carbon credit increases to $170, with a 50% adoption rate for Peterborough County. Please see Appendix B for calculations.

The cost of adoption for both nutrient management and cover cropping is estimated in *Opportunity Assessment of British Columbia's Agricultural Greenhouse Gas Reductions and Carbon Sinks*[12]. The cost of adoption is the expected cost associated with implementing the respective best management practice. The cost of adoption for cover cropping is $47.98 per hectare, while the cost of adoption for nutrient management is $16.72 per hectare[12]. As a result, a more accurate profit estimation can be predicted (Table 3).

Table 3: Expected income generated per hectare annually, considering the cost of adoption, by best management practice in 2023 and 2030. Please see Appendix C for calculations.

Practice	Income in 2023	Income in 2030
Cover Cropping	$46.92	$200.22
Nutrient Management	$22.30	$85.30

Conclusion

Peterborough County should work towards entering the carbon market for financial reasons, but the positive side effects of improved soil quality, sustainability, mitigating climate change and increased agricultural productivity should not be neglected. Entering the carbon market could generate millions of dollars, with the proceeds going to local farmers. A survey and information package should be distributed to all local farmers to assess interest. Soil testing, to determine baseline soil carbon should be completed promptly to maximize the income generated, as all soil carbon accumulated from the sample date onwards is eligible for the carbon market.

Canada is working towards net zero emissions by 2050. Peterborough County can contribute greatly, as a leader in the agricultural industry against climate change, while generating revenue for local farmers. Entering the carbon market as an amalgamated group will give all farmers the opportunity to enter while offsetting barriers, stimulating the rural economy and working to mitigate climate change.

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Appendix A

Table 4: The expected carbon sequestered (CO2e) in tonnes by management type, per year per hectare.[2]

	Crop Land – Cover Crops	Crop Land – Nutrient Management	Crop Land – Reduced Tillage	Pastureland – Silvopasture
Carbon Sequestered (CO2e) in tonnes per year per hectare	1.46t/ha/yr	0.6t/ha/yr	0.13t/ha/yr	0.12t/ha/yr

Table 4 provides the data used to calculate the expected carbon sequestered and expected income generated in Figures 3, 5 & as well as Table 1 & 3.

Appendix B

Calculations for Figure 5 & 6

Figures 3, 5 and 6 utilize the same base equation. Please see below for an example calculation:

$$land\ use\ total\ ha/0.5\ xCO2e\ squestered\ x\ carbon\ credit\ value\ =\ expected\ income$$

Example Calculation for best management practice cover cropping in 2023 (Figure 4):

Number of hectares in crop production in 2022 in Peterborough County (Table 1) multiplied by half to represent a 50% adoption rate. [11]

$$43{,}136\text{ha}\ x\ .05 = 21{,}568\ ha$$

Half of all croplands in Peterborough County multiplied by the expected carbon sequestration (CO2e) potential of cover cropping per year (Table 4).[2]

$$21{,}568\ ha\ x\ 1.46tCO2e/yr\ = 31{,}489.28tCO2e/yr$$

Expected carbon sequestration (CO2e) potential of cover cropping for half of all Peterborough cropland in 2022, multiplied by the value of a carbon credit ($65) (Table 2) to represent expected 2023 income.

$$31{,}489.28tCO2e/yr\ x\ \$65\ = \$2{,}046{,}803.2$$

Appendix C

Table 3 Calculations

Table 3: Expected income generated per hectare annually, considering cost of adoption, by best management practice in 2023 and 2030. [12]

Practice	Income in 2023	Income in 2030
Cover Cropping	$46.92	$200.22
Nutrient Management	$22.30	$85.30

Table 3 Methods:

$$Squestered\ Carbon\ (CO2e)/ha/yr\ x\ value\ of\ carbon\ credit\ -cost\ of\ adoption$$

$$= expected\ income\ generated$$

Cover cropping in 2023, based on hectares of cropland in Peterborough County in 2022:

$$1.46tCO2e/ha/yr\ x\ \$65\ -\$47.98\ =\$46.92$$

Cover cropping in 2030, based on hectares of cropland in Peterborough County in 2022:

$$1.46tCO2e/ha/yr\ x\ \$170\ -\$47.98\ =\$200.22$$

Nutrient management in 2023, based on hectares of cropland in Peterborough County in 2022:

$$0.6tCO2e/ha/yr\ x\ \$170\ -\$16.72\ =\$85.30$$

Nutrient management in 2023, based on hectares of cropland in Peterborough County in 2022:

$$0.6tCO2e/ha/yr\ x\ \$65\ -\$16.72\ =\$22.30$$