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Economic Feasibility of a Wetland Certification Program in the Canadian Prairies

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Abstract

This paper assesses the economic feasibility for a novel market-based instrument for wetland conservation – a certification scheme for agricultural products in the Canadian Prairies. Agricultural producers that restore wetlands on their land would potentially be able to recoup their costs by receiving a price premium for their crops. To assess consumer demand for such a scheme, we designed and administered a stated preference survey to the public in Alberta, Saskatchewan, and Manitoba. The survey included a discrete choice experiment to elicit consumer preferences for attributes of wheat flour including whether the wheat was grown on a certified wetland friendly field. We estimate that consumers are willing to pay 28%-40% more for wetland certified wheat, suggesting potential market demand for a wetland certification scheme. Employing random parameters and latent class logit models, we find substantial preference heterogeneity in consumer preferences and regional differences across the three Prairie Provinces. We translate the consumer price premiums into expected changes in producer net returns and find that the benefits of adopting the wetland certification scheme outweigh the wetland restoration costs for a typical Saskatchewan field. The results suggest that this voluntary wetland certification scheme can be a useful addition to the policy toolbox and assist policymakers in formulating efficient and sustainable wetland management policies.

1.0. Introduction

Wetland conservation remains a critical concern and challenge for Canadian policymakers and the whole agricultural community as Canada holds a quarter (25%) of the world's wetlands (Li and Chen 2005). Despite the numerous identified public benefits of wetlands such as providing fish and wildlife habitat, preserving water quality, and storing floodwaters, many provinces in Canada have experienced a decline in wetland acreage. Wetlands in Canada have been drained at a rate of about 3% per decade (or 0.35% per year) since European settlement in the early 1800s (Dahl and Watmough 2007). The loss of wetlands in the Canadian Prairie Pothole Region (PPR) of Alberta, Saskatchewan and Manitoba is largely due to expansion and intensification of agriculture (Kleijn et al. 2011; Butchart et al. 2010).

The production of agricultural commodities, such as annual crops and intense and widespread animal production, is the major goal of land management in the Canadian PPR. Increased agricultural commodity production has resulted in widespread change and degradation of native prairie ecosystems, limiting their ability to offer the full range of vital ecosystem services. Prairie wetlands play an important role in a variety of agri-ecosystem functions, and their presence and health are essential for the provision of many valuable ecosystem services. Unlike ecosystems in other parts of Canada, prairie wetlands on agricultural landscapes are privately owned and wetland management is challenged by limited markets for the ecosystem services wetlands provide society. While society gains most from wetland conservation, landowners do not receive any economic value for the ecosystem services offered to society. With such a disparity in benefits and costs, it's no surprise that wetlands in the Canadian prairies are continually drained to increase the land's productive value.

This paper conducts an economic assessment of the benefits and costs of a wetland certification program in the Canadian prairies. Agricultural producers that restore wetlands on their land would potentially be able to recoup their costs by receiving a price premium for their crops. We first investigate how much consumers are willing to pay for a certified agricultural commodity produced on wetland friendly landscapes. A stated preference survey including a discrete choice experiment (DCE) is designed and administered to 2,000 prairie residents. Consumer value for wetland conservation is determined through an administration of a questionnaire for purchasing wheat flour with a distinctive wetland label assuring consumers that the wheat was produced on

agricultural land, which has a certain percentage of restored wetlands. Using the choice data, we also assess preference and heterogeneity across respondents and the three the Prairie Provinces of Alberta, Saskatchewan, and Manitoba. Finally, we compare the estimated price premiums for wetland certified wheat to the costs of wetland conservation through a profitability assessment of the producer decision to enroll in a wetland certification program.

Canada's contribution to wetland protection and management has grown substantially since it joined the Ramsar Convention on Wetlands in 1981 (Pattison et al. 2011). The protection and management of wetlands are primarily provincial obligations, according to the Canadian Constitution (Natural Resources Transfer Agreement, 1930). The Federal Policy on Wetland Conservation in Canada (Environmental Canada, 1996) binds all federal departments to a policy of no net loss of wetland function, but only on federal and crown land and waters and it addresses wetland conservation on private land through voluntary individual actions and through public awareness. On the other hand, provincial wetland policies are tailored to the needs of the provinces. Due to the massive private ownership of wetlands on agricultural landscapes, landowners are reluctant with mandatory regulations concerning wetland conservation, which makes market-based approaches to land management more appealing.

One market-based instrument that has not been considered for wetland conservation is a certification program. A certification program is a voluntary process whereby an independent third party assesses the sustainability of a business or production activity relative to a particular standard and then applies a label to distinguish compliant products in the market. While there exists certification scheme for forest products (Forest stewardship Council, Sustainable Forest Initiative, Canadian Standards Association), seafood (Marine Stewardship Council) and other consumer products, no such program exists that targets wetland conservation in agricultural systems. However, a new ecolabel launched by a recent partnership between DUCs, Cereals Canada and Prairie Wheat Growers has brought winter wheat to the forefront of conservations about sustainability. This is the first ecolabel that demonstrates that winter wheat is duck friendly or habitat friendly (Prairie Wheat Growers Report, 2021) which somewhat overlap with goals of any potential wetland certification program.

The success and uptake of certification depends on both the demand and supply side of the markets. Demand for the certified products depends on preferences for the environmental

outcomes, trust in the certifying organization, and other characteristics of individuals such as the level of education (OECD, 2005; Searle et al, 2004; Torgler and Garcia-Valinãs, 2007). Previous studies have emphasized that consumers have a considerable price premium for certification and eco labels for food products (Yang, Hobbs & Natcher 2020; Van Loo et al. 2011; Van-Loo et al. 2015; Yue & Tong 2009; Fonner & Sylvia 2015; O'Briena &Teisl 2004), however consumer stated price premium for environmentally friendly products differ from price premium they offer when it is time to pay at the register. Similarly, there has been mixed findings as to whether the price premiums consumers are reporting for the ecolabels are large enough to offset the cost of certification (Nebel et al. 2005 & Juang et al. 2018).

It is important that agriculture-based certification organizations understand the market and determine where demand already exists (Golden et al. 2010). This makes it easier for environmental advocates to influence the market by raising awareness long before producers consider evaluating their production methods for ecolabeling. Producers must perceive a market benefit before undergoing the costly certification process. Furthermore, producers and retailers need to know that there will be a steady supply so that they may create a brand and meet rising consumer demand. Failure to effectively balance the demand and supply is likely to cause severe market dissatisfaction, which can stop a certification programme before it really gets started.

Wheat provides a useful agricultural commodity to study because it is widely grown across the prairies. Wheat is one of the major crops produced in terms of area (22 million acres) on the Canadian PPR. The implementation of standards in Canada for staple food crop production, such as wheat, has been slower compared to the progress made by Canadian Roundtable for Sustainable Beef (Pattison-Williams, 2018). Implementing wetland standards in the Canadian grain industry can be important because wetlands are more often drained for crop production than for livestock production.

This study contributes to the sustainability certification literature by examining consumer preferences for certified wheat grown on fields with wetland friendly practices in Canada. This study goes beyond estimating price premiums to also assess the feasibility of a certification scheme for wetland ecosystems by comparing the cost of certification of wetlands in terms of the per acre value to the value consumers are willing to pay (price premium) for the certified agricultural product. Answering these will benefit various stakeholders including policy makers and farmers.

Stakeholders will know whether voluntary standard can contribute to wetland conservation while farmers will know whether adopting certification scheme is cost effective.

2.0. Survey design and data

We designed and administered a stated preference survey to assess people's preferences for purchasing wheat flour. We focus on wheat as it is most common crop grown on the Prairies, the single biggest export earner for Canada (Statistics Canada, 2012a), and a relatively common consumer product. The percentage of crops covered by sustainability certification is very small: certification covers 1.1% of global croplands and while heavily traded commodities like coffee, cocoa, tea, and palm oil account for nearly 10% of global production, staple crops like wheat, rice, and maize have much less coverage (Tayleur et al. 2016; Trejo 2015). A stated preference approach was chosen as there is no existing wetland certification scheme for wheat in Canada which limits the use of demand analysis with actual price and transaction data.

Survey design

Survey development is a crucial component for designing a stated preference survey. We conduct both qualitative focus groups and a quantitative pre-test of the survey as recommended by Mitchell and Carson (1993). We conducted three focus groups online on the 6th to 8th of April 2021 with a total of 15 people. Focus group participants were recruited using random digital dial sampling of members of the public from the Prairie Provinces. Each session included a broad demographic composition, including members of both genders and residents of the three provinces. A total six participants lived in Alberta, six in Saskatchewan and 3 people in Manitoba. The sessions lasted 90 minutes and the discussions aimed to obtain basic information and to understand participants' food preferences and knowledge of wetland conservation. Compensation for their participation involved a $50 Amazon gift card.

The survey questionnaire was then pretested on 200 respondents from Alberta and Manitoba using an opt-in online panel. A total number of 99 respondents were randomly selected

from Alberta and 101 respondents from Manitoba. Saskatchewan residents were excluded from this phase in order to preserve them for the main survey administration.

Attributes and the choice experiment

We described wheat flour using a combination of four attributes: level of wetland certification, the organization providing the verification, spot spraying (pesticide control) and price of the wheat flour (Table 1). The levels for certification, verification organization and spot spraying technology were developed based on literature. The levels for the verification body were selected based on the organizations presently involved in conserving wetlands. We use four price ranges, and these were based on actual wheat flour prices at grocery stores in Saskatoon checked in January 2021.

We use an efficient experimental design approach to constructing the choice sets since including the full factorial design would be impractical. Each choice set included two wheat flour profiles and an "opt out" option. All attributes were dummy coded for the design with the exception of price, which we treated as a continuous variable. Unrealistic and dominant profiles were dropped from the design such as wheat flour profiles with varying prices but with the exact same levels of the other attributes as well as wheat flour profiles where certification is present but had an unstated verification organization. The D-efficient Bayesian design identified the best combination of choice sets, which had 48 choice sets blocked into eight blocks. Each respondent was assigned to one of the eight blocks at random and was presented with six complete choice sets. Optimal designs were created using the "idefix" package in R (Traets et al. 2020). Figure 1 shows an example of one of the choice sets presented to respondents, with visual pictures of the wheat flour product included to mirror reality.

Table 1. Attributes and Levels Used in the Wheat Flour Choice Experiment

Attributes	**Description**	**Levels**
Wetland certification level	The level of certification for wheat that is grown on fields with restored wetlands.	• Gold (5% increase in land containing restored wetlands) • Silver (2.5% increase in land containing restored wetlands) • Non- Certified

Verification body	The organization responsible for ensuring the wetlands are being restored	• Provincial govenment • Ducks Unlimited Canada • Producer-led • None
Level of on-farm pesticide application (% change from current)	Whether the farmer uses spot spraying technology that reduces pesticide use in production by 75%	• Reduced by 75% • No Change
Price	The price for a 2.5 kg (5.5 lb) bag of flour.	• $5.25 • $6.75 • $8.25 • $9.75

"Now suppose YOU are shopping for wheat flour. Please examine each choice below, keeping in mind that, in a real-life situation, you would be paying for the product that you choose, and if you spent more on this product, you

would have less money to spend on other things. Make the choice that most closely reflects what your decision would be in an actual shopping situation."

	Option 1	**Option 2**	**Option 3**
			I would not purchase any of these products.
Wetland certification level	Gold level (5% increase in restored wetlands on land)	None	
Verification body	Ducks Unlimited Canada	None	
Level of on-farm pesticide application (% change from current)	Reduced by 75%	No change	
Price for 2.5 kg (5.5 lb)	$7.00	$5.25	
I would choose…	□	□	□

Figure 1. Example of a choice set presented to respondents.

Survey structure

The final stated preference survey instrument consisted of 36 questions over four sections. After completing the consent form, the first section of the questionnaire asked for consumer attitudes and habits concerning food in general and introduced participants of the study to the

overall state, significance and decline of wetlands in Canada specifically the Canadian Prairie pothole region. This was followed by the DCE itself, where consumers were presented with the wheat flour purchasing decisions characterized by the attributes described earlier. The third section of the survey asked respondents a referendum voting question that is not the focus of the current paper. The last section included socio-demographics questions, debriefing, and auxiliary questions about the understanding of the DCE.

Survey Administration and Sample Representativeness

The main survey was administered online in June 2021 by Asking Canada, an online survey company, to its representative English-speaking Canadian consumer panels in the Canadian Prairie Provinces. The target population are people who buy wheat flour in the Canadian Prairies, 18 years or older and who spoke English. A total of 2,000 individuals completed the survey with 871 survey responses collected from respondents in Alberta, 318 from Saskatchewan and 811 from Manitoba. The average time for completing the survey was between 20 to 25 minutes.

The sample is broadly representative of the Canadian prairie population in terms of the age distribution and gender due to the quota-based sampling method implemented. Table A2 in the Appendix compares the sample to 2016 population census data. The distribution of males and females in our sample is similar to that of the Prairie population. The percentage for males in Alberta, Saskatchewan and Manitoba is 49.9%, 49.1% and 48.9% as compared to that of the population census, which is 50.1%, 49.9% and 49.4%. The percentage for females is 50.2%, 50.5% and 51.2% for Alberta Saskatchewan and Manitoba as compared to that of the 2016 population census that 49.9%, 50.4% and 50.6%. However, the sample population leans toward a slightly more educated and higher-income demographic in all three Prairie Provinces, as is common in Internet-based surveys (Szolnoki and Hoffman, 2013). For the number of children in the family, we did not include those without children and therefore some of averages does not add to 100%.

3.0. *Estimating the consumer benefits of wetland certification*

The choice experiment data is analysed using the random utility theory, which assumes that consumers choose alternatives that provide them the highest utility from a choice set. The utility U_{ijt} of an individual *i*, from alternative *j*, during choice occasion *t*, consist of a deterministic

(observed) component, V_{ijt}, and a random or stochastic component, ε_{ijt} (Thurstone, 1927; McFadden, 1974). In our context, the observed component includes the non-monetary attributes of the wheat flour including wetland certification level, verification organization, and spot spraying technology and the price. The unobserved component embodies all information not available to the researcher but are exclusive to the individual making the choice. To mimic actual purchasing options, each choice set includes an opt-out option, which is modelled with an alternative-specific constant.

$$U_{ijt} = V_{ijt} + \varepsilon_{ijt} \tag{4.1}$$

Hence, the statistical model of the probability (P_{ij}) that alternative j is chosen by individual i is given by:

$$P_{ijt} = P(V_{ijt} + \varepsilon_{ijt} > V_{ikt} + \varepsilon_{ikt}) \quad \forall\, k \neq j \tag{4.2}$$

The multinomial logit model (MNL) is a basic starting point from which other advanced models in the discrete choice model family can be derived. Due to its simplicity, the MNL model has traditionally been used to analyze choice experiment data. This model presupposes that consumers' tastes are homogeneous across the population. That is, the probability of consumer *i* choosing alternative *j* can be estimated by equation (4.3) with a MNL model under the assumption that ε_{ijt} is independent and identically distributed with type I extreme value distribution (Louviere et al., 2000; McFadden, 1974). Hence, a MNL model can represent the ith consumer's probability of selecting the jth wheat flour in choice occasion t:

$$P_{ijt} = \frac{e^{X_{ijt}\beta}}{\sum_j^J e^{X_{ijt}\beta}} \quad \forall\, j = 1, \dots, J \tag{4.3}$$

The MNL model, however, has three main limitations (Train, 2009). The primary limitation is that it disregards variation in the estimated coefficients and is unable to account for unobserved preference heterogeneity. The second major limitation of the MNL model is its well-known independence of irrelevant alternatives (IIA) assumption or property. The IIA property holds that the probability ratio between any two alternatives is completely independent of the existence and characteristics of any other alternatives (Ben-Akiva and Lerman, 1985).

Furthermore, the MNL model assumes that there is no correlation across choice sets for the same individual.

However, in the economics literature, several approaches, such as the random parameter logit (RPL) model have been developed to address the limitations of the MNL model. Bhat (1997) and Train (1998) developed the RPL model to recognise a wide range of consumer preference heterogeneity. In contrast to the MNL model, the RPL model allows for greater flexibility and a continuous form of preference heterogeneity; utility coefficients vary across individuals based on continuous probability distribution functions (Chang, Lusk, & Norwood 2009). The multinomial logit model and the random parameter logit model is used to analyze the preferences of the respondents.

The WTP for each wheat flour attribute is computed in order to interpret the estimated parameters, determine the monetary values associated with changes in each attribute, and assess the value for the cost benefit analysis (CBA). The welfare change is estimated by taking the negative ratio of the coefficient of the non-monetary attribute to that of the monetary attribute known as the marginal willingness to pay (MWTP). The MWTP is the maximum amount that the respondent would be willing to pay in order to receive/avoid a specific product attribute (Burton et al. 2001). The marginal WTP is calculated as follows:

$$MWTP = \frac{\beta_k}{-\beta_{price}} \tag{4.3}$$

Where β_k is the marginal utility of the parameter estimates for the non-monetary attribute and β_{price} is the marginal disutility of price, which is represented as the coefficient of the monetary attribute in the CE.

4.0. Comparing producer benefits to wetland restoration costs

To determine if a wetland certification scheme makes financial sense from an agricultural producer's perspective, we compare the expected profit per quarter section a producer receives under the certification program to the expected profit per quarter section a producer receives without a certification program. The average profit per acre for each field is computed for locations outside of wetland basins for comparison. Producer net returns are obtained by averaging the total profits for both wheat and canola. If the benefits outweigh the expenses, the initiative benefits the producer; if the costs surpass the benefit, the project harms producer.

We focus the analysis on a representative field in Saskatchewan where the producer practices a wheat–canola rotation. We make the assumption that the certification program only applies to wheat production so prices received for canola are the same with and without certification. Farm economic revenue and costs are based on information average of spring wheat and canola across the black soil zone provided by the Saskatchewan Crop Planning Guide 2021. For spring wheat, the total yield per acre is about 68.3 bushels and the price received by producers is $6.04 (Saskatchewan Crop Planning Guide 2021). The total fixed and variable cost for wheat production are $119.57/acre and $284.23/acre respectively.

It is further assumed that the premium is paid for the non-wetland acres in the quarter section of a landscape (160 acres). The average weight of spring wheat per bushel was about 27.216 kg and we assume that 75% of flour is wheat based on information received from Ardent Mills in downtown Saskatoon. However, the producer only receives 6% of the price per every bag of wheat flour sold. The percentage the producer receives is estimated based on the price of a bushel of wheat and the market price of the bag of wheat flour.

The total revenue a producer obtains is estimated by converting the price premium for the two different wetland certification levels to a $/acre value that we could expect the farmer to receive when they adopt wetland certification scheme. The implementation of a certification system can induce substantial costs such as transactions costs. We included a transaction cost of 1.5% retail turnover price of a bag of wheat flour based on research for organic certification by Rundgren (2001). Once the total revenue is estimated under each scenario, we then estimate the cost of wheat production per quarter section under each scenario. We assumed that the cost of production includes the fixed and variable costs of production, and these are based on 2021 estimates provided by the Saskatchewan Crop planning Guide, 2021. The cost of wetland restoration is added to the total cost Table A1 in the Appendix summarises assumptions used to calculate producer profit.

Based on these assumptions, the producer's total profit (TP) per quarter section is represented by Equation (4.4) by subtracting the total cost (TC) from the total revenue (TR) for each scenario. We had three different scenarios for wetland certification, that is the gold wetland certification (8 acres of wetland restored per 160 acres quarter section), silver wetland certification

label (4 acres of wetland restored per 160 acres quarter section) and non-certified (0 acres of restored hectares).

$$Total\ Profit(TP) = Total\ Revenue(TR) - Total\ Cost(TC) \quad (4.4)$$

Where:

*TR= Price received by producers($/acre/year) * Yield((bushels/acre) * Number of the Productive Acres*

And

$$TC_0 = Fixed\ Cost * (All\ acres) + Variable\ cost * (Productive\ acres) + Restoration\ cost * (\text{Wetland acres}) \quad (4.5)$$

5.0. *Empirical Results*

Perception of food labels and wetland loss

We first present descriptive results from several questions that assessed consumer knowledge and perceptions before discussing the model results. Consumer knowledge about food labels and the importance and extent of wetland loss could be an important component in understanding consumer value for wetland conservation. The survey gathered information on how often respondents read food labels and their familiarity CRSB certified, Canada Organic, FSC and MSC labels. Almost half of the sample were familiar with the Canada Organic label, 36 % are familiar with the MSC label followed by the FSC label (35%) and approximately 22% are familiar with the CRSB label. Figure 2 summarises the responses. The number of respondents who had no knowledge of any of the labels presented in the survey was about 25%. This shows that majority of the respondents were familiar with sustainable labels. Consumers' concern for food labels is viewed as a prerequisite for them to purchase foods with environmental labelling.

To examine respondents' concern for wetland ecosystems, we assessed whether the respondents had information on the importance of wetlands, wetland ecosystem services and the extent of wetland loss in the Canadian PPR. Respondents were asked, "Do you know of any wetlands in your local area". Approximately 61% of the participants indicated knowing about wetland in their local area, while 29% answered no to this question. In addition, 49% had visited wetlands in their local area, while 42% had not visited any wetlands. This suggests that the many

respondents knew about wetlands. Based on respondents' perception a majority (approximately 80%) of the sample population indicated that they felt that all four categories of ecosystem services are extremely important as seen in Figure 3. Despite the importance of ecosystem services to the respondents, about 49% admitted that they knew about wetland loss in the Canadian PPR while 46% had no knowledge of the extent of this wetland loss in the Canadian PPR. Participants who showed concern about the loss of wetlands outnumbered those who were unconcerned suggesting these consumers may have a positive view of a product with a label indicating the product was sourced from a farm in involved in the conservation of wetlands in the Canadian PPR.

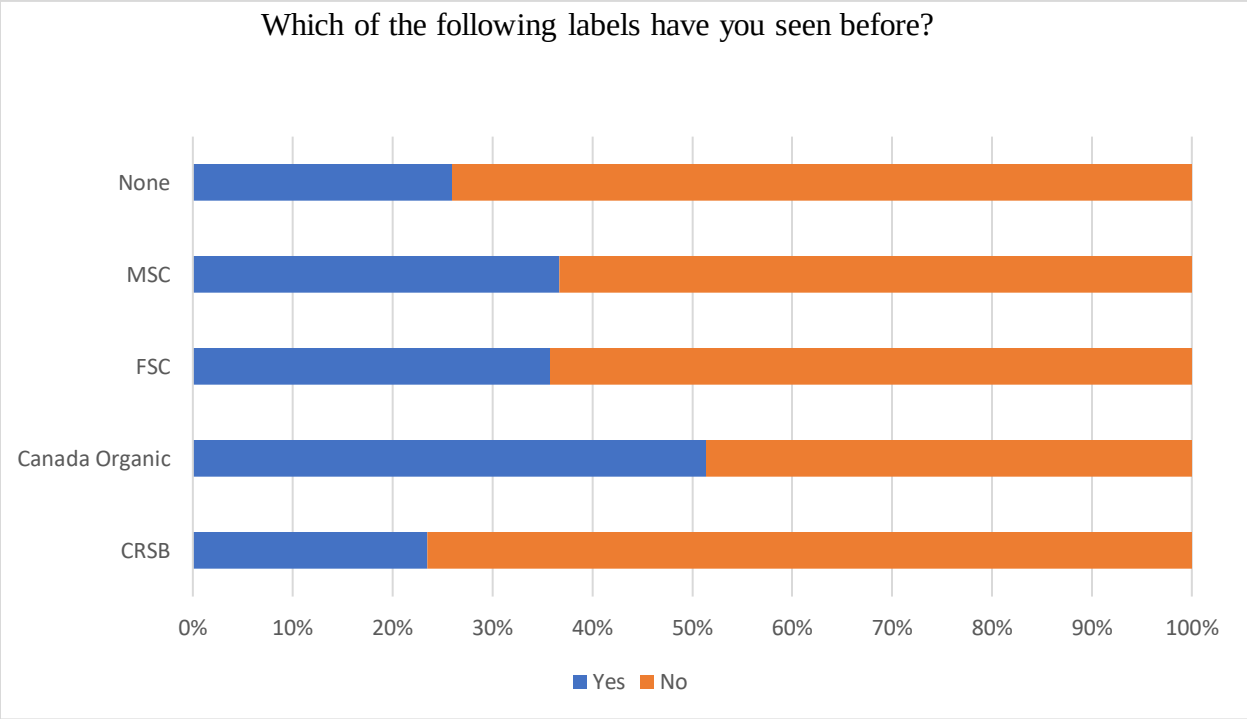

Figure 2. Respondents' Familiarity with Four Different Ecolabels in Canada

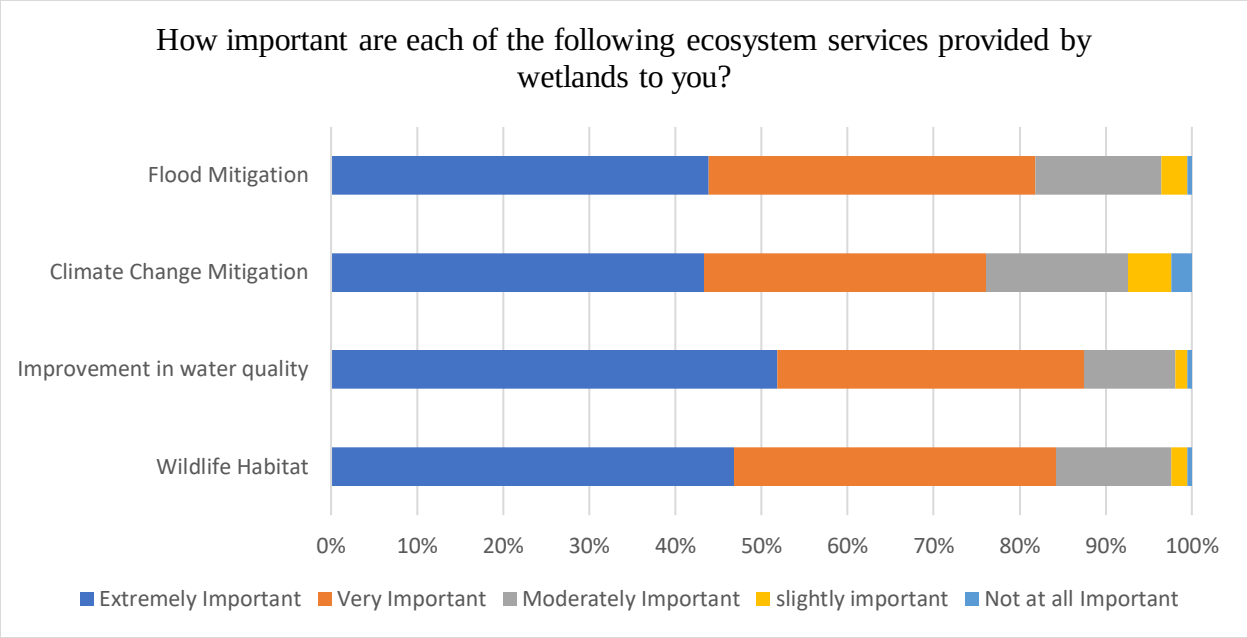

Figure 3. Respondents' Perception of the Importance of Wetland Ecosystem Services.

A question posed to evaluate participants' perception towards wetland conservation. This line of questioning was included to capture whether participants would trust either the government or the farmer to protect wetlands. About 23% of the respondents strongly agreed to the statement that the government is responsible for the conservation of wetlands as seen in Figure 4 and 39% stated that they somewhat agreed to the statement. However, a relatively lower percentage was recorded for farmer's responsibility towards wetland conservation, which is seen in Figure 5. Only 15% of the respondents strongly agreed and 43% somewhat agreed to the statement that the farmer is responsible for the conservation of wetlands. Wetland conservation in Canada is regulated by both the government and private organization and this may be an indication that the sampled population feels that each stakeholder is responsible for wetland conservation.

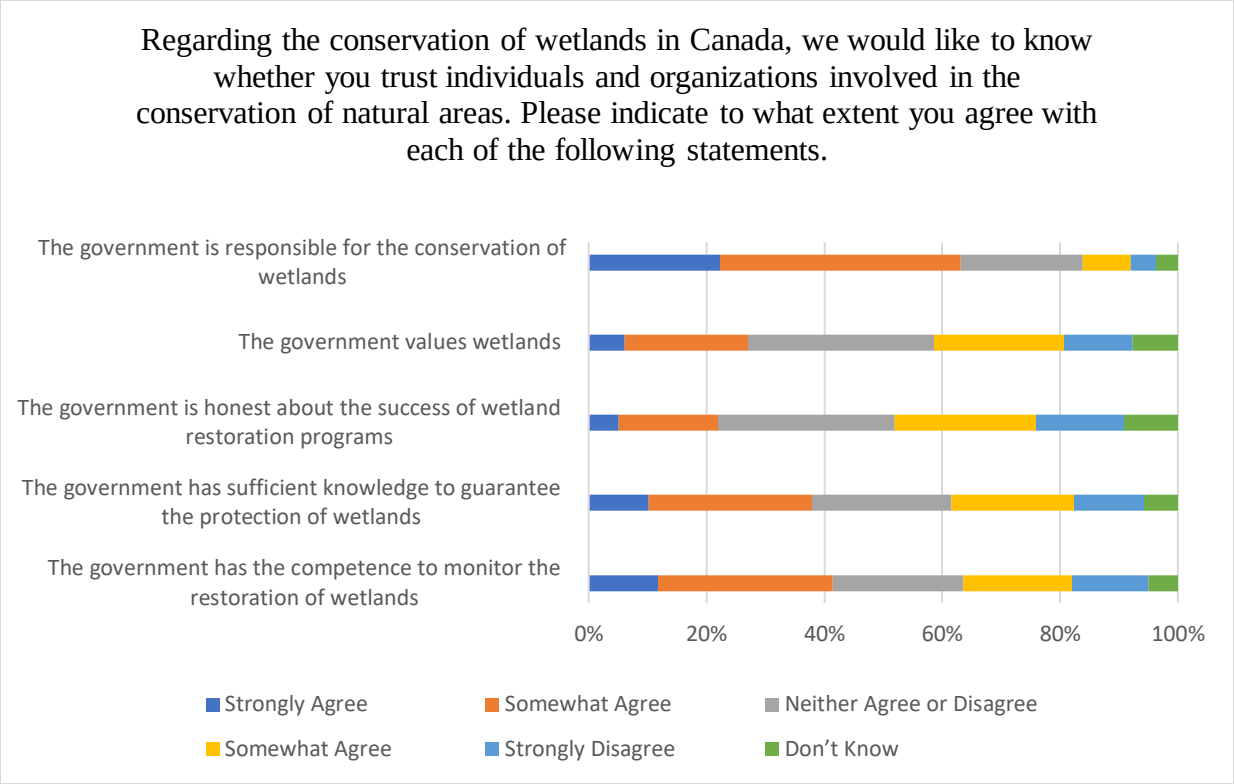

Figure 4. Respondents' Perception of Government's Responsibility towards Wetland Conservation

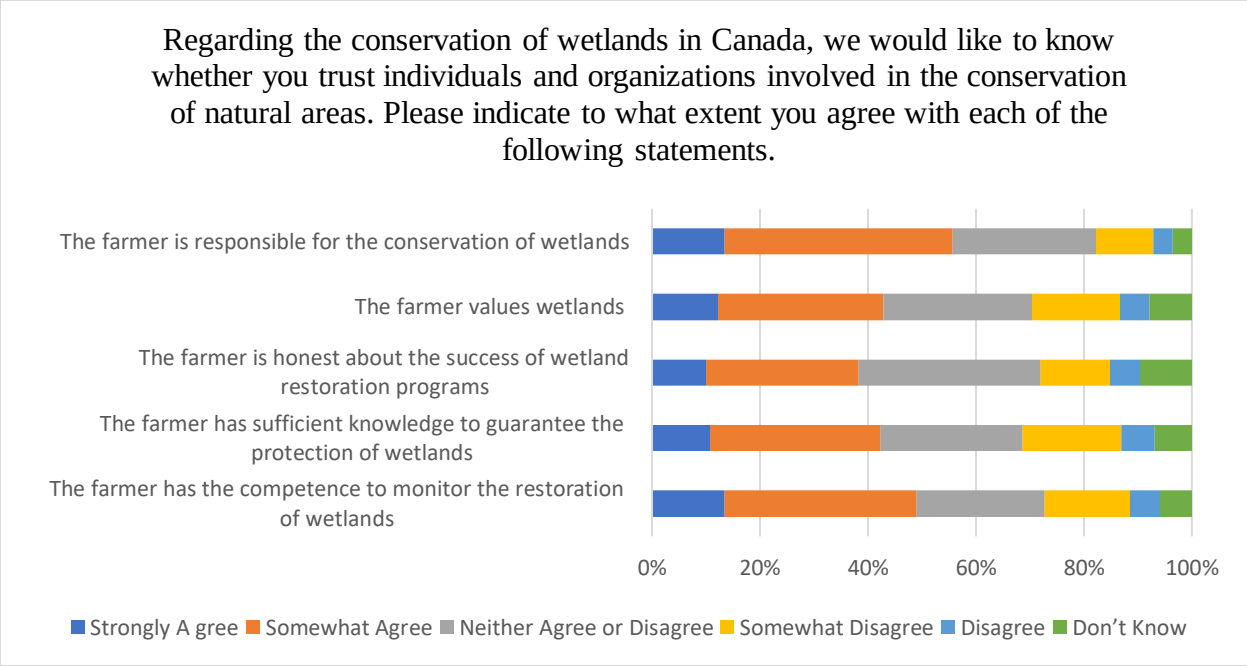

Figure 5. Respondents' Perception of Farmers' Responsibility towards Wetland Conservation

Choice Model Results

Table 2 presents the results from the MNL model for the full sample. All coefficients are statistically significant at the 1% level except for the verification organization attributes. Canadian consumers prefer "wetland-friendly" wheat flour with gold or silver certification to the non-certified wheat flour. The parameter estimates indicates that consumers derive a higher level of utility from a higher level of wetland restoration. Thus, consumers associated a stronger preference for the gold wetland certification label than the silver wetland certification label. In terms of verification organization, consumers prefer that the wetland certification scheme be certified and audited by either Ducks Unlimited, or the provincial government as compared to the producer-led organization.

In terms of the other wheat attributes, consumers prefer wheat cultivated with a 75% reduction in on-farm pesticide application, to wheat that is cultivated on a farm with no reduction in pesticide use. The price coefficient of wheat flour is negative indicating that an increase in price decreases the probability of choosing a bag of wheat flour. The negative opt-out option estimate indicates that consumers, on average, prefer to buy wheat flour products featured in the choice experiment rather than the "opt-out" option when all other attributes levels are zero.

The mean coefficients from the RPL model also described in Table 2 for the total sample are similar to those of the MNL model. All mean coefficients are statistically significant at 1% except for the mean coefficient for wheat flour certified by the producer-led organization, which is statistically significant at 10%. The certification parameter results imply that consumers prefer a wetland certified wheat flour to the non-certified wheat flour. Counterintuitively, the results indicate that there is a higher increase in utility when the silver label is present compared to the gold label. For the verification organization attribute, consumers have a strong positive preference for wheat flour certified by Ducks Unlimited, but consumers prefer wheat flour certified by the provincial government to the producer-led organization, which is similar to the results of the MNL model. Consumers also expressed their preference for wheat flour grown on a land with a 75% reduction in pesticide use.

The standard deviations for all attributes are statistically significant at 1% for the full sample. The significant standard deviation estimates for the attribute parameters imply that

consumers are heterogeneous in their preferences. For example, the large estimated standard deviation for the producer-led verification organization suggests there is substantial preference heterogeneity in contrast to the relatively small in magnitude estimated mean parameter which suggests people care less about this attribute.

When comparing the summary statistics across the MNL and RPL models, there is a reduction in the Bayesian information criterion (BIC) and Akaike information criterion (AIC) associated with the RPL model. The significant standard deviations estimated in the RPL model also imply that there is important preference heterogeneity not accounted for in the MNL model.

Table 2 also presents the results for the differences in preferences in Alberta, Saskatchewan and Manitoba. The MNL and RPL models are estimated for each prairie province (See Table A3 in the appendix for MNL results for each prairie province). In all cases, we find that the price of a bag of wheat flour has a negative effect on the decision to choose wheat flour. When price is zero, wheat consumers in the three provinces prefer the wheat alternatives presented to them in the study to the opt-out option. The results also indicate that respondents are more likely to choose certified wheat flour to non-certified wheat flour in all three provincial subsamples. Consumers also expressed their preference for wheat flour grown on a land with a 75% reduction in pesticide use. A difference in the preferences of Saskatchewan residents is that they are more likely to choose wheat flour certified by Ducks Unlimited and the producer -led organization to the provincial government while respondents from Alberta and Manitoba prefer wheat flour certified by Ducks Unlimited and the provincial government to wheat flour certified by the producer-led organization. The lack of statistical significance of the Ducks Unlimited and producer-led organization coefficients in Saskatchewan and Manitoba may show consumers lower level of knowledge and familiarity with the role such organizations play in wetland restoration. On the other hand, wheat flour consumers in Alberta may be aware of the role Ducks Unlimited and provincial government play in the restoration of wetlands. A possible explanation for this difference may be the fact that Saskatchewan wheat flour consumers may be largely rural and are aware of the active drainage and lack of regulations/policy concerning wetland restoration in Saskatchewan, while wheat flour consumers in Alberta and Manitoba are urban. Saskatchewan wheat consumers may therefore trust a producer-led organization to act as the verification organization.

Table 2. Discrete Choice Model Results for the Total Sample and Prairies Provinces

	Total sample			Saskatchewan		Alberta		Manitoba	
	MNL	RPL		RPL		RPL		RPL	
	Coefficient	Mean Coefficient	Standard deviation	Mean Coefficient	Standard Deviation	Mean Coefficient	Standard Deviation	Mean Coefficient	Standard Deviation
Opt-Out	-3.038***	-6.842***	3.78***	-7.379***	4.343***	-7.162***	3.923***	-6.353***	3.549***
	(0.065)	(0.199)	(0.156)	(0.546)	(0.471)	(0.316)	(0.245)	(0.291)	(0.236)
Gold certification[a]	1.117***	1.479***	0.065***	1.254***	0.049	1.615***	0.021	1.425***	0.007
	(0.047)	(0.066)	(0.004)	(0.161)	(3.5)	(0.102)	(0.0008)	(0.096)	(0.011)
Silver certification	0.934***	1.898***	1.014***	1.756***	1.223***	2.077***	1.07***	1.774***	0.907***
	(0.045)	(0.077)	(0.067)	(0.197)	(0.179)	(0.12)	(0.105)	(0.111)	(0.1)
Verification Organization[b]									
Ducks Unlimited	0.077**	0.181***	0.07***	0.24	0.113	0.265***	-0.027	0.091 (0.064)	0.046
	(0.029)	(0.051)	(0.021)	(0.148)	(0.251)	(0.079)	(0.041)		(0.043)
Producer-led Organization	-0.077*	-0.092*	0.665***	0.117	0.53 (0.344)	-0.212**	0.795***	-0.042	0.472**
	(0.033)	(0.051)	(0.106)	(0.161)		(0.085)	(0.156)	(0.065)	(0.188)
75% reduction in pesticide use	0.637***	1.124***	1.68***	0.965***	1.645***	1.182***	1.777***	1.12***	1.581***
	(0.03)	(0.061)	(0.067)	(0.158)	(0.172)	(0.097)	(0.107)	(0.093)	(0.097)
Price	-0.373***	-0.649***		-0.667***		-0.697***		-0.596***	
	(0.009)	(0.016)		(0.043)		(0.027)		(0.025)	
Log-likelihood	-9904.53	-8084.87		-1190.81		-3528.13		-3352.49	
AIC	19823.07	16195.73		2407.62		7082.26		6730.98	
BIC	19874.04	16290.4		2477.75		7166.34		6813.91	
# of respondents	1822	1822		280		806		736	
# of choices	10932	10932		1627		4762		4354	
# of parameters	7	13		13		13		13	

Notes: Standard errors in parentheses. Asterisks indicate statistical significance where *p<0.1, **p<0.05, and ***p<0. [a] Non-certified is the omitted category. [b] Provincial government is the omitted category.

Price Premium for Wetland Certification

Using the estimated coefficients from each model, the MWTP[1] for a bag of wheat flour with various attributes is calculated and displayed in Table 3. For the MNL model, consumers are willing to pay 40% premium for the gold wetland certification label on a bag of wheat flour and 33% for the silver wetland certification label on a bag of wheat flour. This demonstrates that consumers are willing to pay a higher premium for a higher level of wetland restoration (5% increase in land containing restored wetlands) to that of a lower level of wetland restoration (2.5% increase in land containing restored wetlands). While consumers are willing to pay 3% premium for a bag of wheat flour certified by Ducks Unlimited attribute, they are however unwilling to pay for a bag of wheat flour certified by the producer-led organization attribute. For the 75% reduction in pesticide use, the associated price premium is 23%.

Examining the RPL model MWTP estimates, we can observe a fall in the willingness to pay estimate for gold wetland certification label and an increase in the price premium for the silver wetland certification label in the RPL model for the full sample. Prairie consumers are willing to pay $2.28 (30%) more for the gold label on a bag of wheat flour and $2.92 (39%) more for the silver label on a bag of wheat flour. This comes as a surprise since consumers are willing to pay higher premium for a lower wetland restoration level and this is different from the price premium obtained in the MNL model. There is also an increase in the willingness to pay estimate for wheat flour certified by Ducks Unlimited from $0.21 (3%) to $0.28 (4%). However, consumers are still unwilling to pay for a bag of wheat flour certified by the producer-led organization attribute. The price premium for the 75% reduction in pesticide use is $1.73 (22%).

[1] We used the average price ($7.5) of the prices presented in the DCE to convert the price premiums to percentages

Table 3. Marginal Willingness-to-Pay Estimates for Wetland Certification Attributes Across Provinces.

	Total Sample		Saskatchewan	Manitoba	Alberta
Variables	MNL	RPL	RPL	RPL	RPL
Gold level	\$2.99	\$2.28	\$1.95	\$2.39	\$2.32
	(0.113)	(0.090)	(0.208)	(0.142)	(0.129)
Silver level	\$2.50	\$2.92	\$2.67	\$2.97	\$2.98
	(0.114)	(0.100)	(0.236)	(0.155)	(0.145)
Ducks Unlimited	\$0.21	\$0.28	\$0.26	\$0.15	\$0.38
	(0.078)	(0.078)	(0.176)	(0.107)	(0.112)
Producer-led Organization	\$-0.21	\$-0.14	\$0.07	\$-0.07	\$-0.31
	(0.089)	(0.079)	(0.10)	(0.109)	(0.123)
75% reduction in pesticide use	\$1.71	\$1.73	\$1.55	\$1.88	\$1.70
	(0.064)	(0.082)	(0.199)	(0.133)	(0.121)

Note All price premiums are in Canadian dollars and the values in the parentheses are standard errors associated with each price premium

The WTP estimates for wetland certification are similar is highest in Manitoba followed by Alberta but lowest in Saskatchewan. Wheat consumers in Saskatchewan expressed a relatively lower WTP for wetland certification. Another difference between the provinces was that Saskatchewan consumers were willing to pay \$0.17 (2%) more for wheat flour with a wetland certification label verified by the producer-led organization to the provincial government. This is different in the Alberta and Manitoba.

Based on the welfare estimates across all three models, the results support the existence of a potential demand for a wetland certification scheme by Prairie consumers. Thus, wetland certification labels matter to consumers. The highest price premium for a bag of wheat flour with a wetland certification was recorded in Manitoba, followed by Alberta and then Saskatchewan. However, Alberta and Manitoba consumers expressed a strong preference for a product certified by Ducks Unlimited and the provincial government as verification organizations as compared to the producer-led organization. A possible explanation why we see these differences can be attributed to the fact that Saskatchewan respondents may be largely rural while respondents from that Alberta and Manitoba maybe urban and may not be aware of any producer-led organizations currently involved in wetland restoration. They are more confident in a recognised wetland

restoration organization or the provincial government to act a verification organization. The findings of this study confirm the results of other existing studies in that consumers have a strong preference for ecolabels and other certification schemes (Yang, Hobbs & Natcher 2020; Xie et al. 2010; Van Loo et al. 2011). However, the market demand alone is not sufficient to confirm the success of such a certification scheme even though the results detected some level of demand from consumers.

The Profitability of a Wetland Certification Scheme from a Producer's standpoint

Using a representative field in Saskatchewan using a wheat-canola rotation, we compared the price premiums producers would receive to the wetland restoration costs. Table 4 presents these results. Overall profitability of wetland certification is obtained by comparing the rotation profits the producer obtained under wetland certification to the rotation profits the producer obtains without wetland certification. Without certification and any restored wetlands, the average annual profits for the rotation on this field is estimated to be $80/acre.

Saskatchewan consumers are willing to pay a 28% to 35% price premium for certification which translates into a producer price premium of producers receive about 19% to 26% for certification. The producer only receives this price premium for wheat produced and canola prices are the same with and without certification. For gold certification, the average annual field level profitability for a wheat- canola rotation is $96 to $118 per acre depending on the wetland restoration costs. Under the silver wetland certification program, the annual profits ranged between $101 and $112 per acre.

Adopting the certification scheme, the change in annual rotation profits is estimated to be $16 to $38 per acre if 8 acres of wetlands are restored on a quarter section (i.e. the gold certification) and $21 to $32 per acre if 4 acres of wetlands are restored (i.e. silver certification). The estimates above suggest that it is more profitable to adopt a wetland certification scheme. These estimates reflect that a wetland certification program may be a feasible policy alternative and could incentivise the production of wetland ecosystem services.

Table 4. Producer Profit Received per Quarter Section with and without Wetland Certification

	Gold Wetland Certification		Silver Wetland Certification		Without Certification
Wheat revenue					
Price received by producers ($ per bushel)	$7.6		$7.2		$6.04
Yield (bushels/acre)	68.3		68.3		68.3
Number of productive acres	152		156		160
Revenue for quarter section	$78,900		$76,715		$66,005
Wheat costs	Low	High	Low	High	
Annualized wetland restoration costs ($/acre)	$50	$500	$50	$500	$0
Operating costs for a quarter section	$62,334	$62,334	$63,471	$63,471	$64,608
Total cost for a quarter section	$62,734	$66,334	$63,671	$65,471	$64,608
Wheat profits					
For a quarter section	$16,166	$12,566	$13,044	$11,244	$1,397
Per acre	$101	$79	$81	$70	$9
Canola profits per acre	$134	$112	$142	$131	$150
Rotation profits per acre	$118	$96	$112	$101	$80
Change in profits relative to no certification	$38	$16	$32	$21	-

Note The total profit per acre is total profit per quarter section divided by the total number of acres

6.0. *Conclusion*

Can a potential wetland certification scheme align consumer benefits and producer costs and incentivise the provision of wetland ecosystem services? The results of the current study provides some affirmative evidence. The study adds to the literature by using a choice set experimental design to determine whether there is a market demand for a wetland certification program and assesses the price premium producers require for a functioning wetland certification.

Findings of this study have important implications for policy makers and the whole agriculture community. The major policy implication of this study is that there is market potential for a wetland certification program on the Canadian prairies as the price premium consumers are willing to pay offsets the additional wetland restoration costs for producers. Moreover, the

attitudinal analysis suggests that consumers care about the ecosystem services provided by wetland and are concerned about the wetland loss in the Canadian PPR. In addition, the results of this paper demonstrates that wetland certification can be beneficial to the producer. A producer who practices wheat-canola rotation under either gold or silver wetland certification is likely to enjoy about $16 to $38 more than a conventional producer. The profitability of adopting a certification label can serve as an incentive for the provision of ecosystem services in agricultural landscapes. Therefore, both consumers and producers are motivated to support conservation of wetlands with the right policies in place. Policy makers can potentially develop an efficient wetland certification scheme that targets wetland restoration on farmlands.

The introduction of a wetland certification label must be accompanied by initiatives to raise consumer awareness and understanding of what this instrument actually entails. Despite the proliferation of sustainability label in the system, Grunert et al. (2014), reported that consumer knowledge and use of labels are considerably low. Consumer must be given information outlining how a wetland certification programme differs from other certification schemes and justify the need to add another certification to an already saturated food information market. Thus, in order to develop an effective scheme for wetlands, the wetland certification scheme should follow a clearly defined environmental that will clarify issues that may render the certification scheme ineffective. On the other hand, for a functioning wetland certification program, producers must be willing to abide by its procedures and standards. This type of wetland certification may require producers to commit to a no drainage of wetlands (no-net-loss) in their operations. This is likely not a problem for Alberta and Manitoba where wetlands regulations exist to protect wetlands but may be an issue for Saskatchewan landowners/ producers where there is still active drainage of wetlands and there is currently no existing wetland conservation policy. Stakeholders can consider this when developing a wetland certification.

The development and implementation of wetland certification program does not only provide stakeholder with a voluntary approach to restoring wetlands but also provides the agricultural industry with an opportunity to promote wetland restoration through an agricultural product. Due to the massive private ownership of lands on agricultural landscapes, landowners are reluctant with mandatory regulations concerning wetland restoration. A wetland certification program provides stakeholders with a voluntary market-based approach to wetland restoration. Certifications schemes are voluntary as such the financial and societal consequences arise from

consumers. Recent agriculture sustainable trends in Canada such as the new ecolabel implemented by Ducks Unlimited for "duck-friendly" winter wheat (Wheat Growers report 2016) somewhat overlap with goals of any potential wetland certification program. The Canadian agricultural industry may use this as an opportunity to promote wetland conservation through staple crops because the implementation of certifications schemes for the crops is perhaps the most significant as more wetlands are drained for crop production than for the livestock industry.

Consumer confidence in sustainability standards is an important component for certification. If a consumer is willing to pay a premium for environmental sustainability, sufficient frameworks must be in place to guarantee supply chain reliability and transparency (Pattison, 2018). The certification organization to audit the compliance of farms plays a significant role. Most wetland drainage occur on private farms hence thousands of owners so the auditing and verification for farms is relatively difficult. The results suggested that consumers are more likely to purchase wheat flour certified by Ducks Unlimited and the provincial government as compared to a producer-led organisation. Stakeholders in the development of a wetland certification program can use this study as a guide. This will ensure the confidence of the public in the initiatives of this certification scheme.

The study suggests a number of areas for future research. First, this study mainly discusses wheat flour as the certified commodity in the choice experiment. Other agricultural products can be studied since the type of product is likely to have an influence on the visual attention behaviour of consumers when making food choices. Consumer reactions to other commodities produced in the PPR, such as oats and barley can be investigated further to see if similar price premium is found for other agricultural products cultivated with canola. Wheat produced in the Canadian PPR is largely exported to other countries. However, this study only assesses the domestic demand for a "wetland friendly" certified wheat flour. Producers who want to pursue wetland certification must be able to sell their products in China, USA and other parts of the world or else this could limit the growth and usefulness of the wetland certification scheme, especially if the exporting markets have no consumer demand for ecolabels.

An introduction of a wetland certification label for wheat would require a separate supply chain. Although Canadian manufacturers, food processors and retailers are under pressure to meet global trends for these standards, setting up a new supply chain for certified wheat faces many challenges. For instance, the initial cost associated with wetland certification may be too high for

small-scale wheat producers. Wheat is bought and sold largely as a commodity rather than a branded product and even though there may be a domestic demand for certified wheat flour, this may not be the same for the international market. The international market may have little to no concern for domestic wetlands and as such they may buy conventional wheat because certified wheat will be sold at a relatively higher price will compete with other conventional wheat. We recommend that future studies investigate the difficulty in setting up a new supply chain for certified wheat.

Although these findings provide evidence to support the profitability of a wetland certification program to the producer, these estimations may not actually reflect the exact amount the producer receives under certification due to the reliability of parameter estimates assumed. The parameters assumed in calculating the profit are based on the 2021 Saskatchewan Crop Guide and as such prices, yields and costs are dynamic and bound to change year-to-year. Future research could expand on the producer side by taking in account these changes and by estimating the threshold for which wetland certification may not be beneficial to the producer.

The study uses responses to a stated preference survey to estimate consumer demand and there are potential concerns with the use of these surveys. The stated preference survey was limited to the Canadian Prairies and the sample size was relatively small. Although we used best practices in survey design to mitigate hypothetical bias, actual choice behaviour may differ from consumers' survey choices. Overall, the findings should be interpreted with caution, given the survey was only limited to wheat consumers in Alberta, Saskatchewan and Manitoba. Due to the sample size, some of the variables examined in the WTP model were not statistically significant. The Saskatchewan sample was relatively smaller than Alberta and Manitoba. Future studies should consider a large sample size to enhance the degree of freedom in order to address the statistical limitation.

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Appendix

Economic Feasibility Assessment

Table A1. Assumptions and Parameter Values for Estimating Producer Net Returns

Variable	Assumptions	Source
	Wheat	
Flour to wheat proportion	75%	Ardent Mills
Number of 2.5 Kilogram of wheat flour per bushel	14.5 units	Based on estimation
Price of wheat per bushel	$6.04	Saskatchewan Crop Planning Guide, 2021
Yield per acre	68.3bushels	Saskatchewan Crop Planning Guide, 2021
Percentage of wheat flour sale the farmer receives	6% of retail wheat flour price	Estimated value based on retail value of wheat flour and farm gate prices of wheat/bushel
Bag of wheat flour	2.5kg	Based on the wheat flour used in the study
Average price of 2.5kg bag of wheat	$7	Average market wheat price from Saskatoon, January 2021.
Variable Costs	$284.23/acre	Saskatchewan Crop Planning Guide, 2021
Fixed costs	$119.57/acre	Saskatchewan Crop Planning Guide, 2021
Restoration costs per year (per acre)	$50-$500	Tyndall, J., and T. Bowman (2016)
Certification transaction costs	1.5% of retail wheat flour price (25% of producer portion)	Rundgren, 2001
	Canola	
Price of canola per bushel	$11.25	Saskatchewan Crop Planning Guide, 2021
Yield per acre	56 bushels	Saskatchewan Crop Planning Guide, 2021
Variable Costs	$360.23	Saskatchewan Crop Planning Guide, 2021
Fixed costs	$119.57	Saskatchewan Crop Planning Guide, 2021

Total Revenue under each Scenario

Scenario 1 ~ Total revenue under gold label certification

$$TR_{gold\_cert} = (0.06 - 0.015) * (Price\ premium + base\ price) * \left(\frac{0.75}{2.5}\right) * Yield\ per\ acre * (160 - 8) \quad (5.18)$$

Scenario 2 ~ Total revenue under silver label certification

$$TR_{silver\_cert} = (0.06 - 0.015) * (Price\ premium + base\ price) * \left(\frac{0.75}{2.5}\right) * yield\ per\ acre * [(160 - 4)] \quad (5.19)$$

Scenario 3 ~ Total revenue for Non-certified

$$TR_{non\_cert} = 0.06(base\ price) * \left(\frac{0.75}{2.5}\right) * yield\ per\ acre * [(160 - 0)] \quad (5.20)$$

Total Cost under each Scenario

Scenario 1~ Total cost under gold certification label

$$TC_{gold_{cert}} = Fixed\ cost * (160) + Variable\ costs * (152) + Restoration\ cost * (8) \quad (5.22)$$

Scenario 2 ~ Total cost under silver certification label

$$TC_{sliver\_cert} = Fixed\ cost * (160) + Variable\ costs * (156) + Restoration\ cost * (4) \quad (5.23)$$

Scenario 3 ~ Total cost for non-certified

$$TC_{non\_cert} = (Fixed\ costs + Variable\ costs) * (160) \quad (5.24)$$

Table A2. Socio-demographic Characteristics of the Survey Sample for the Three Prairie Provinces as Well as Comparative Information of these Characteristics from the 2016 Census for Each Province.

Socio-demographic characteristic		Percent of total					
		Alberta		Saskatchewan		Manitoba	
		Survey Sample	2016 Census	Survey Sample	2016 Census	Survey Sample	2016 Census
Gender (%)	Male	49.9	50.1	49.1	49.7	48.9	49.4
	Female	50.2	49.9	50.5	50.3	51.2	50.6
Age (years)	18-34	31.9	28.2	30.0	26.7	29.6	19.9
	35-54	36.2	28.0	32.6	25.1	33.5	25.8
	55 & over	31.9	24.6	32.5	28.6	37.0	28.5
Highest level of education completed	Below Bachelor's degree	40.9	54.5	56.9	61.6	57.5	55.5
	Bachelor's degree	27.2	16.5	2.4	13.2	24.9	14.4
	Post graduate study	14.6	4.9	15.1	3.4	12.3	3.5
Annual household income before taxes ($)	$39,999 & under	16.8	17.3	25.2	24.5	25.3	26.6
	$40,000-$79,000	14.9	24.3	21.4	28.7	19.9	31.7
	$80,000-$124,999	29.7	23.4	25.2	22.5	26.6	22.8
	$125,000 & over	24.8	34.5	17.6	24.6	15.0	11.6
Number of people in family	1~2	57.4	58.3	59.8	63.5	61.8	61.4
	3~4	34.2	31.3	34.2	26.8	32.6	28.2
	5 or above	8.3	10.4	8.3	9.5	5.7	10.4
Number of children in family	1	71.0	32.8	63.8	33.0	76.6	27.7
	2	14.0	37.2	17.6	35.0	12.1	33.7
	3 or more	14.8	18.4	18.6	21.4	11.3	14.5

Table A3. Results of the Multinomial Logit Model for Each of the Prairie Province

	MNL		
	Saskatchewan	**Alberta**	**Manitoba**

Attributes	Levels	Coefficient (Standard Errors)	Coefficient (Standard Errors)	Coefficient (Standard Errors)
	Opt-Out	-3.131***(0.165)	-3.075***(0.099)	-2.972*** (0.105)
Wetland Certification label	Gold level	0.994***(0.121)	1.169*** (0.072)	1.109*** (0.096)
	Silver level	0.786***(0.117)	0.977*** (0.069)	0.946*** (0.095)
Verification Organization	Ducks Unlimited	0.081(0.094)	0.093** (0.046)	0.057 (0.106)
	Producer-led Organization	0.064(0.094)	-0.166*** (0.049)	-0.035 (0.113)
Pesticide Reduction	75% reduction in pesticide use	0.51***(0.076)	0.637*** (0.045)	0.682*** (0.047)
Price		-0.379***(0.024)	-0.382*** (0.0137)	-0.363*** (0.015)
Log-likelihood		-1504.56	-4376.14	-4013.567
AIC		3023.13	8766.28	8041.13
BIC		3060.89	8811.56	8085.79
# of respondents		280	806	736
# of choices		1627	4762	4354
# of parameters		7	7	7