Comparing Willingness-to-pay and Willingness-to-accept Approaches for Valuing Farmland Protection and Conversion in Alberta

by

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ABSTRACT

Over the last three decades, Alberta has experienced substantial urban sprawl, with some of the province's most productive agricultural land developed into residential, light industrial and retail uses. The converted farmland provided not only market commodities, but also a variety of environmental services. Many of these environmental services are non-tradeable public goods and their value cannot be directly estimated from market data. We use choice experiments to calculate these non-market values using Willingness to Pay (WTP) and Willingness to Accept (WTA) approaches. The general objective of our study is to inform decision makers about the values gained and lost when land is converted from agriculture to other uses. In Alberta, government policies make municipalities responsible for land use planning and authorization of permitted land uses.

The six most populated urban areas in Alberta were chosen as study areas: Edmonton, Calgary, Lethbridge, Red Deer, Grande Prairie and Medicine Hat. In each choice experiment survey, people were required to consider whether they prefer the current development trend to an additional conservation (WTP) or additional development (WTA) strategy. Data were collected through a procedure that included an efficient design, consequentiality questions, focus groups, pre-tests, soft launch, and full launch. The full launch of the online surveys collected complete data from 1,303 respondents. Multinomial Logit, Latent Class, and Random Parameter Logit Models were used to analyze the choice experiment data and calculate respondents' willingness-to-pay and willingness-to-accept compensation for protection and conversion of agricultural land located near urban areas.

The WTP and WTA results can be used to gauge public support for the acceptance or denial of applications for land re-designation, which could be considered a passive or reactive policy tool. The results can also be used in the design of more proactive and targeted policy tools, such as conservation easements, that could be used to identify and protect the most highly valued agricultural land or development fees, such as transferable development credits or conservation offsets, that could be levied on developers interested in converting land from agriculture to developed uses. Both the passive and active approaches require conversations and public debate about acceptable limits to private property rights and the public interest in land use.

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Chapter1. Introduction

1.1. General Background

Agricultural land is a key input into farming systems that produce a wide array of grains, oilseeds, legumes, livestock, vegetables and tree products. Agricultural land does not only feed people. It also provides economic, environmental, and sociocultural benefits by creating jobs, generating tax revenue, producing ecosystem services, supporting agritourism, and providing wildlife habitat. The mix of private and public goods produced by agricultural land makes it the subject of decisions by both private farmers and public authorities at various levels of government. Increasing populations require not only more of these goods and services, but also more land for urban uses such as commercial, light industrial and residential (Seto et al., 2017). Coping with the loss of agricultural land is a policy challenge to governments across the world. In Europe, around two-thirds of the cropland lost in 2005 was converted to urban uses (Oliveira et al., 2019). Since the mid-1950s, a variety of farmland protection policies has been instituted in the United States due to concerns about the loss of farmland (Duke & Lynch, 2007).

Alberta is one of Canada's three prairie provinces and the fourth most populous province after Quebec, Ontario and British Columbia. The population growth rate of Alberta was approximately 7.2% from 2013 to 2017, which is higher than the average of 4.4% for Canada (Statistics Canada, 2017). Growth in gross domestic product (GDP) in Alberta has been relatively high in recent decades, although it is forecast to be the lowest in Canada in 2019. In 2018, the real gross domestic product (GDP) of Alberta increased by 2.4% to $335.0 billion. Mining, quarrying, and oil and gas extraction grew 6.4%, which was highest among all industries, followed by transportation and warehousing (5.0%) and wholesale trade (5.0%) (Government of Alberta, 2019a). Much of the

economic growth in Alberta has occurred on the extensive margins of cities as low-density suburbs and commercial development have spread onto surrounding rural land (Qiu et al, 2015).

With an area of 661,185 square kilometers (255,200 square miles), Alberta covers approximately 7% of Canada's land mass. It includes various landscapes: mountains, glaciers, lakes, wetlands, badlands, forests, rivers, foothills, and open plains (Government of Alberta, 2016a). The total area of farms in Alberta was 50.3 million acres in 2016, compared with 50.5 million acres in 2011, equating to a 0.5 percent decline in five years. Over the same period, there was a 6% decline in the total number of farms (Government of Canada, 2018), and a corresponding increase in average farm size. At the provincial level, increases in farming area in the sparsely populated northern part of the province have largely offset reductions in the more densely populated southern part. Decreases in the area of farmland have been particularly large in the areas around Edmonton and Calgary and the corridor area between the two cities. Between 2000 and 2012, the area of agricultural land in the corridor decreased by 7%, while the area of developed land increased by 39.4% (Qiu et al, 2015)[1]. Across the province, 306,163 acres of farmland was converted from agriculture to developed uses between 2000 and 2012, 70.3% of which was classified as the highest or second highest farmland quality (Haarsma and Qiu, 2017). The main reasons for the reduction of total agricultural area in the corridor area were urban population growth and an expansionary approach to urban development.

[1] Using data from Qiu et al (2015) for the corridor area, we calculate that the average annual conversion of agricultural land to developed uses was 0.162% between 2000 and 2012. We compared this to equivalent rates for EU countries between 2000 and 2006. We found that only three EU countries, Albania, Netherlands and Cyrus had higher rates of conversion. The other 35 countries had much lower rates, ranging from 0.07% to 0% per year. (Eurostat, 2019)

Figure 1.1 Albertan Average % Change in Farmland Values between 2000 and 2018

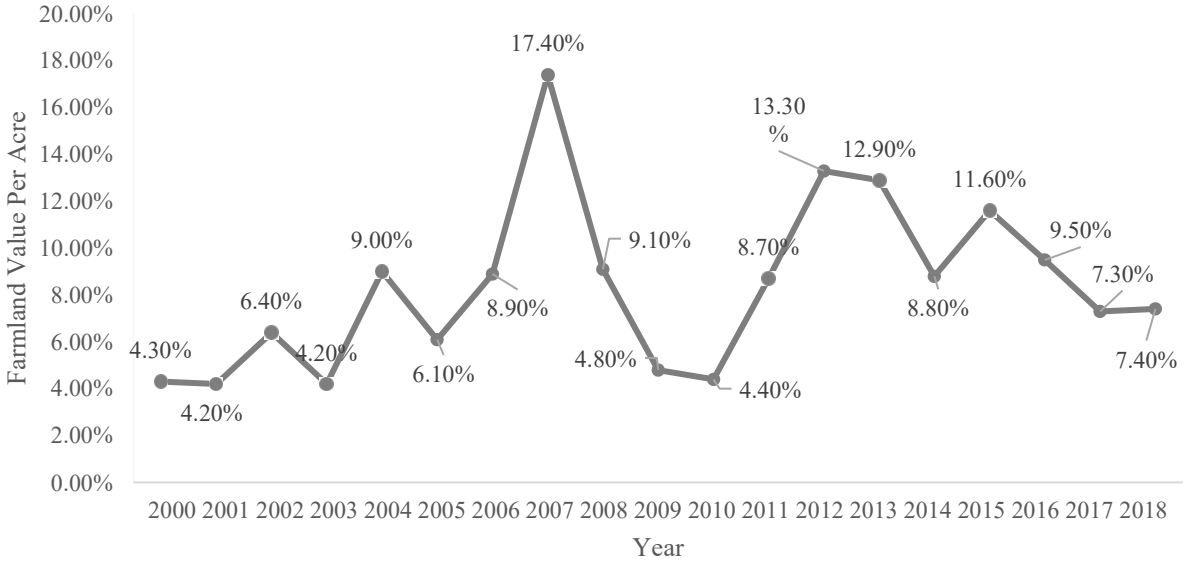


Figure 1.1 Albertan Average % Change in Farmland Values

Data Source: (Farm Credit Canada, 2018)

The market value of farmland depends on its agricultural production value, residential value, and potential to be converted into higher value alternative uses. Between 2000 and 2018, average farmland values in Alberta increased by an average of 8.8% per year (own calculation based on Farm Credit Canada data, see Figure 1.1), partly due to a rise in expected farm earnings and partly due to a rise in the value of the option to convert to developed uses (Plantinga and Miller, 2001). In a province-wide study of the determinants of Alberta farmland prices, Bentley (2016) found that, all else equal, farms located near to Highway 2, near Edmonton and near Calgary traded at substantially higher prices than farms located further from the two major population centers and the Edmonton-Calgary corridor. This suggests that factors other than agricultural productive value

are driving farmland prices in the areas of Alberta that are most likely to be converted into alternative uses.

Responding to concerns about the rapid rise in farmland values and the effects of land conversion, Canadian governments have put policies in place to protect farmland and slow its conversion. In southern Ontario, for example, the *Greenbelt Act* preserves undeveloped and agricultural land near urban areas (Ontario Ministry of Municipal Affairs and Housing, 2017). In British Columbia, the *Agricultural Land Reserve Use Regulation (ALR)* identifies a provincial land-use zone to conserve farming and ranching activities (Provincial Agricultural Land Commission, 2014). No equivalent farmland protection policy has yet been enacted by the Province of Alberta. The most relevant provincial policies that have been enacted are the Land Use Framework (2008) and the Municipal Government Act (modified 2019). This policy environment is described in the following section of this chapter.

As noted above, farmland provides not only market commodities, but also a range of environmental services that should also be taken into account. Most of these services are public goods, therefore they are often non-tradable, with values that cannot be directly estimated from market data. Evaluating the non-market value of agricultural land can generate evidence on which to base decisions and policies about land conservation and development. Accurate assessment of values can help avoid inefficient agricultural land uses and reduce the risk of losing high-quality agricultural land. However, the non-market value of these public goods is often underestimated because the external social benefits are ignored (Lopez, Shah & Altobello, 1994). Farmland not only improves the quality of water, soil, carbon sequestration and air, but also promotes biodiversity conservation (Center for Agriculture in the Environment, 2005). Twohig-Bennett &

Jones (2018) find that open space provides various health benefits such as reducing diastolic blood pressure, incidence of type II diabetes and stroke, cardiovascular mortality and other disease morbidities.

Stated choice methods have been used to estimate non-market values of land currently used for agriculture. Bowker & Didychuk (1994) assess the nonmarket value for retention of farmland in the Moncton area of New Brunswick. They used the payment card contingent valuation method to elicit household willingness-to-pay to preserve given units of the Moncton area farmland base. In the Alberta context, Wang & Swallow (2015) used a choice experiment approach to elicit the nonmarket values that residents in the Alberta Capital Region would be willing to pay (WTP) to have land conserved in agricultural uses. The WTP approach implicitly assumes that farmers have the right to develop their land into non-agricultural uses. In the Alberta context, however, there is no legal reason why farm owners should assume the right to convert land to alternative uses. For example, under the Alberta Land Stewardship Act, the government has the power to limit development of private land if deemed to be in the public interest (Kaplinsky and Percy, n.d). Conversion can instead be viewed as a privatization of the public good benefits of agricultural land uses. Therefore, if the public has the right to the non-market services of agricultural lands, then we should also consider residents' willingness to accept (WTA) compensation for losing these open spaces. Estimation of both WTP and WTA is thus the key focus of this thesis. By comparing the WTP and WTA results, we can clarify the implications of adopting either of these two different policy perspectives.

Petrolia and Kim (2011) attempted to address the contrast between WTP and WTA in their study of the value of coastal wetlands in the State of Louisiana (USA). In their study, willingness to pay

(WTP) is the amount of money that respondents are willing to pay to prevent expected future losses, while willingness to accept represents the monetary compensation that they would need to receive to compensate for the land loss. Unfortunately, Petrolia and Kim (2011) express little confidence in the reliability of their WTA results. More recently, Lloyd-Smith & Adamowicz (2018) prove the feasibility of using the WTA method in stated preference. Their results show that the incentive compatibility of WTA is useful for public good valuation if responses have consequences for respondents. Trenholm et al (2018) find that benefit transfers of WTA are as valid and reliable as benefit transfers of WTP. By comparing WTP and WTA estimates derived using the choice experiment method, we can further add to this limited literature.

1.2. Study Context

1.2.1. Policy context

Private land use in Alberta is governed by an array of provincial and municipal laws and acts. At the broadest level, the Alberta Land Stewardship Act (2009) mandates the provincial government to develop regional land use plans and authorizes the provincial cabinet to adopt regional plans for seven regions, including Lower Athabasca, Lower Peace, North Saskatchewan, Red Deer, South Saskatchewan, Upper Athabasca and Upper Peace. So far, only the Lower Athabasca and South Saskatchewan regional plans have been approved. These plans are legally binding on both public and private lands and on every land use authority in the province. Regional plans may impose significant limitations on the private use of land without compensation, provided that some reasonable private use of the property is left to the owner (Kaplinsky and Percy, 2016).

Within the framework of the regional plans (where they hold), the Municipal Government Act (MGA) grants jurisdiction over land use planning on private lands to municipal governments. This

gives municipal governments the power to protect agricultural land from both fragmentation and conversion through their ability to reject applications for rezoning of agricultural land to other uses. This policy approach tends to be reactive and ad hoc, such that Councilors are often concerned about making decisions that are consistent and fair. Provincial direction on agricultural land use protection is outlined in the 1996 Municipal Affairs publication, *Land Use Policies* (Alberta Government, 1996), which "encourages" municipalities to identify where agricultural land should be a primary land use, to limit fragmentation of agricultural land, to direct non-agricultural uses of land to areas where development will not constrain agricultural activities, and to minimize conflicts between agricultural land and other uses. Recent changes to the MGA place greater expectations on municipal governments to develop and enforce Municipal Development Plans (MDPs) that protect agricultural land. Growth Management Boards have been constituted around the cities of Calgary and Edmonton to promote joint planning for land use and infrastructure development. Growth Management plans must be approved by the Provincial government. Municipalities outside of the two Growth Management Boards are now required to develop Inter-municipal Development Plans (IDP) as a means to coordinate land use and service planning between municipalities that share a common boundary.

While MDPs and IDPs outline municipal ambitions regarding future land use, each municipality's Land Use Bylaw (LUB) lays out the legal limitations as to what uses are permitted on different parcels of private land. Municipal regulations on subdivision outline how parcels of land can be subdivided into smaller parcels. Most municipalities have some land zoned (designated) as agricultural land which has a very narrow set of allowable uses. To develop these parcels of land (into residential, commercial, or industrial) a change in approved land use, or 'rezoning' must take

place. Rezoning can be initiated by the municipality or a landowner. A similar process is required for land subdivision. Municipal councils have the final say as to whether a rezoning and/or subdivision application is approved.

The *Alberta Land Stewardship Act* (ALSA) established additional tools for agricultural land protection, including conservation easements, conservation offsets, conservation directives and transfer of development credits. Under a conservation easement, a landowner agrees to abide by a list of land use restrictions in order to support the protection, conservation and enhancement of 1) the environment, 2) natural scenic or esthetic values, or 3) agricultural land or land for agricultural purposes (Environmental Law Centre and Miistakis Institute, 2019). Conservation organizations often purchase development rights and sometimes donate those rights to land trusts. In Alberta, a land trust is a not-for-profit, non-governmental organization established to conserve land for specific conservation objectives, with those objectives specified in the articles of incorporation. The two largest land trusts operating in Alberta are The Nature Conservancy of Canada, which focuses on land with high scientific value, and Ducks Unlimited Canada, which focuses on wetlands and other habitat areas. There are at least 7 other smaller land trusts that concentrate on particular areas of Alberta, some of which are concerned with open spaces, watersheds, natural landscapes, native grasslands, or working landscapes of ranch and farm land (Legacy Land Trust Society, 2019). The document '*Conservation Easements for Agriculture in Alberta'* reviews the policy and status of agricultural conservation easements in Alberta (Chiasson et al., 2012). Apart from conservation easements, the *Alberta Land Stewardship Act* enables the use of Transferable Development Credits (TDC) as a tool to simultaneously achieve development and conservation objectives. Transferable development credit (TDC) programs are popular in United States (also

called Transferable Development Rights). Transferable Development Credits allow landowners in designated conservation areas to sell development credits to developers, but still own and use the land for agriculture. Developers purchase development credits and redeem those credits to build houses, retail outlets or other commercial buildings in designated developed areas (also called "built areas"). Because TDC programs are often multi-jurisdictional, various authorities are often involved. The *Alberta Stewardship Act (ALSA)* identifies the procedures that municipalities should follow to establish local TDC programs under the auspices of the Land Use Secretariat (Miistakis Institute, 2013). An example of TDC has been initiated by Rocky View County near Calgary. Rocky View has developed an Area Structure Plan for the Glenbow Ranch region of 7,359 acres that incorporates both conservation easements in designated conservation areas and transfer of development credits in built areas (Rocky View County, 2017). Otherwise, however, neither conservation easements nor TDC programs have been widely applied in Alberta (Driedzic, 2016). This leaves the acceptance or rejection of subdivision and/or rezoning applications as the principal approach to limit land use fragmentation and conversion in the province. As noted above, this approach tends to be reactive and ad hoc.

1.2.2. Study Areas

As mentioned, a study of willingness to pay for protection of agricultural land was previously undertaken for Alberta's capital region, which includes the City of Edmonton and a number of surrounding urban and rural municipalities (Wang and Swallow, 2016). For the current study, we wanted to be able to evaluate change in WTP over time and compare WTP estimates across the urban areas of the province. We thus chose to include the Edmonton area as a starting point. Alberta has 18 cities which are mostly located in the central and southern parts of the province.

We considered two aspects of these urban areas: population density and potential development. On that basis, we selected the 6 most populous cities and the surrounding areas that could be developed in future years. For the cities with larger populations, we consider the Census Metropolitan Area (CMA), and for the cities with smaller populations, we consider the Census Agglomeration (CA). A census metropolitan area (CMA) or a census agglomeration (CA) is formed by one or more adjacent municipalities centered on a population center (known as the core). A CMA must have a total population of at least 100,000 of which 50,000 or more people must live in the core. A CA must have a core population of at least 10,000. Calgary CMA is the most populous CMA in Alberta and the 5th largest most populous CMA in Canada. From 2011 to 2016, Calgary CMA had the highest population increase (14.6%), followed by Edmonton CMA with a 13.9% increase. Edmonton is the second most populous CMA. Red Deer CA and Lethbridge CMA rank in third and the fourth place, with increases of 10.9% and 10.8% respectively between 2011 and 2016. Medicine Hat CA has the fifth largest population, which increased by 5.1% between 2011 and 2016. The least populous urban area included in this study is Grande Prairie, which had an increase of 13.5%. Figure 1.5 shows the population of these four areas in 2001, 2006, 2011 and 2016. Together the Edmonton CMA and Calgary CMA currently comprise around 66.7% of the Alberta population.

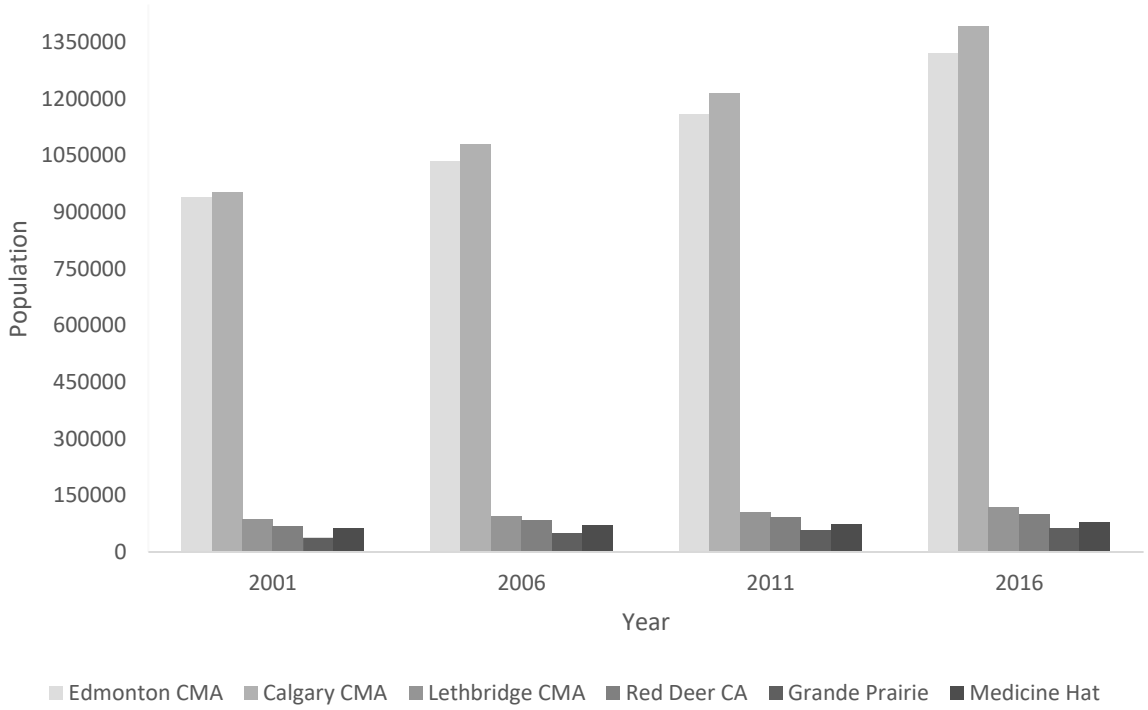


Figure 1.2 Population in Edmonton CMA, Calgary CMA, Lethbridge CMA and Red Deer CA between 2001 and 2016. (Data Source: Government of Canada, 2017)

In order to assess potential for development, we used ArcGIS to calculate the acres of agricultural land loss and increase of developed land use between 2000 and 2016 for each of the six study areas. The green shaded areas represent the developed land in 2000, while the red shaded areas represent land that was converted from agricultural to developed uses between 2000 to 2016. Figures 1.3 to 1.8 show that the conversion has primarily taken the form of suburban development on the periphery of the cities.

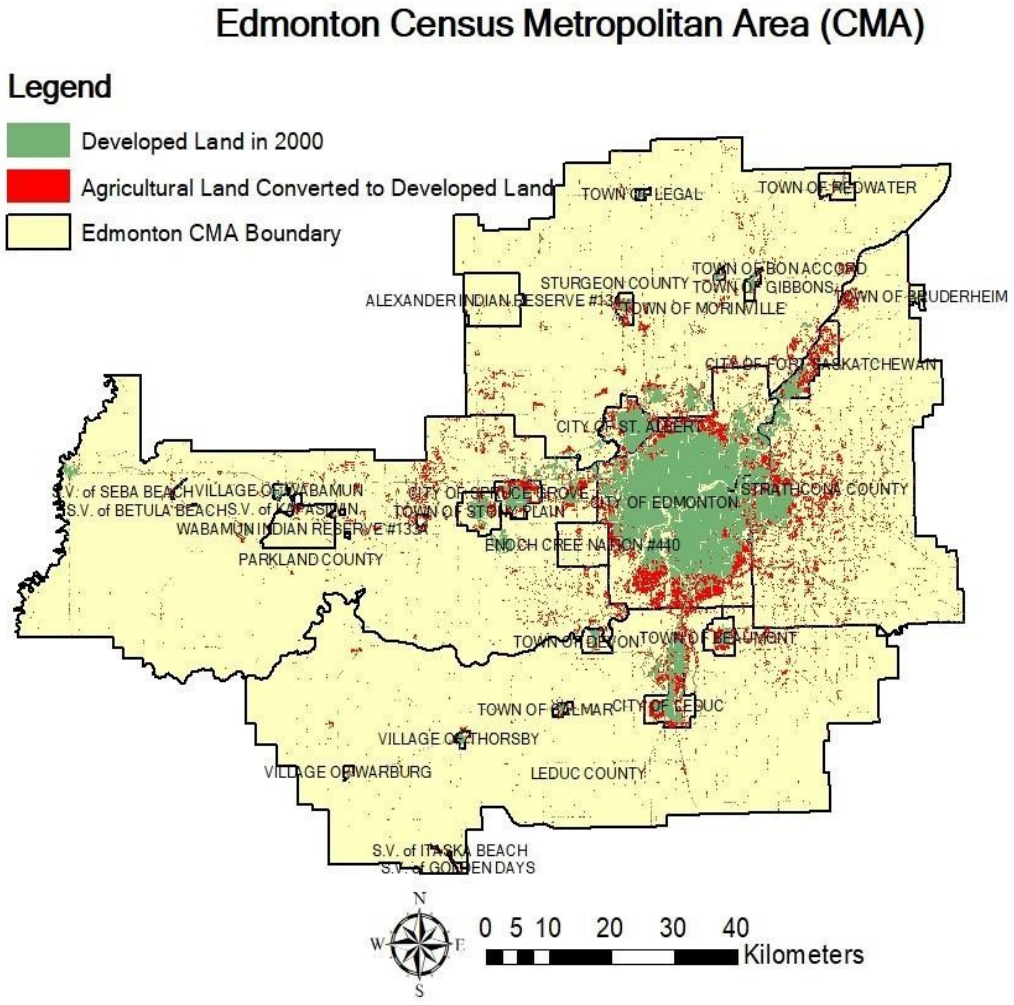


Figure 1.3 2000-2016 Development Trend Continues in Edmonton CMA (Source: author's analysis of crop inventory data from Agriculture and Agrifood Canada)

Figure 1.3 displays the development trend of agricultural land in the Edmonton Census metropolitan area from 2000 to 2016. Developed land increased by 128,710 acres, a 75.5% increase. Approximately 92% of the newly developed land was converted from agriculture. This represented a 7.2% reduction in agricultural land in the CMA.

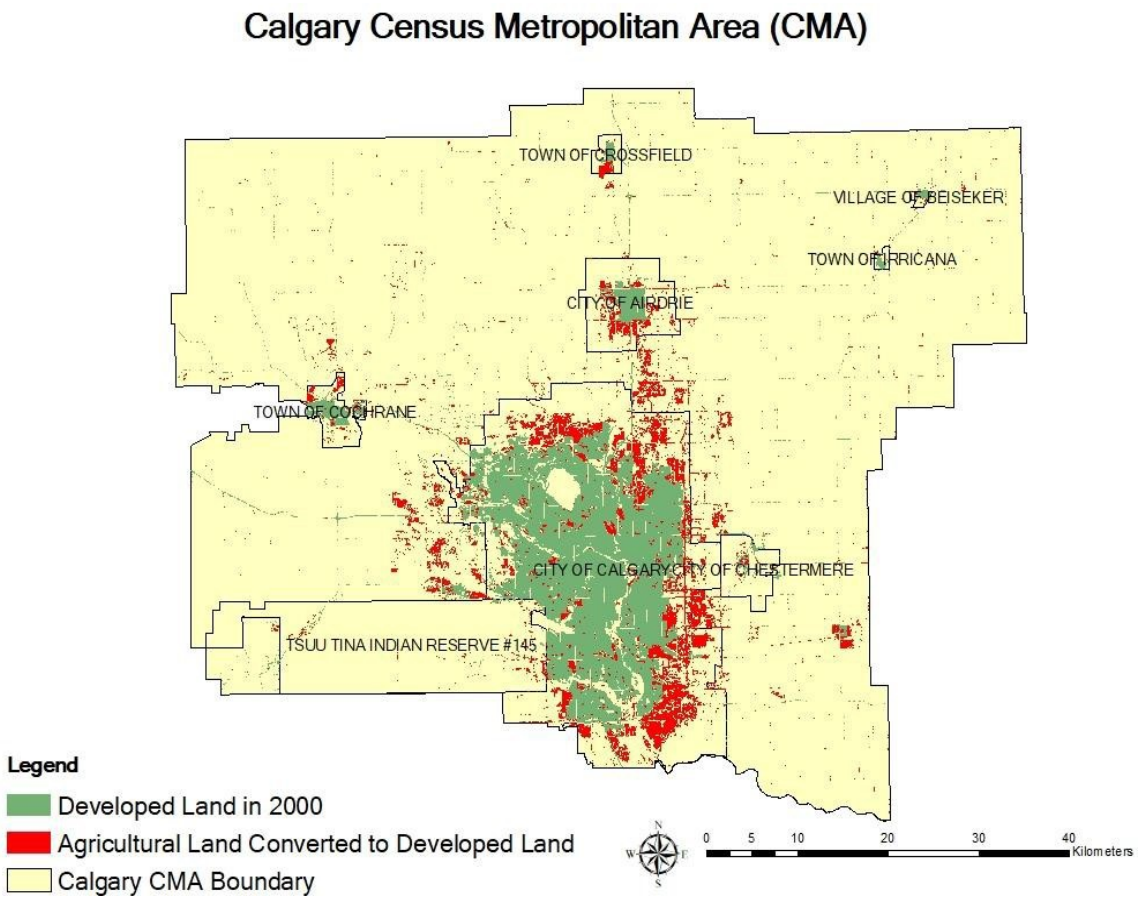


Figure 1.4 2000-2016 Development Trend Continues in Calgary CMA (Source: author's analysis of crop inventory data from Agriculture and Agrifood Canada)

Figure 1.4 shows the development trend of agricultural land in the Calgary Census metropolitan area from 2000 to 2016. Developed land increased by 72,462 acres, a 63% increase. Approximately 71% of the newly developed land was converted from agriculture. This represented a 6.6% decrease in agricultural land in the CMA.

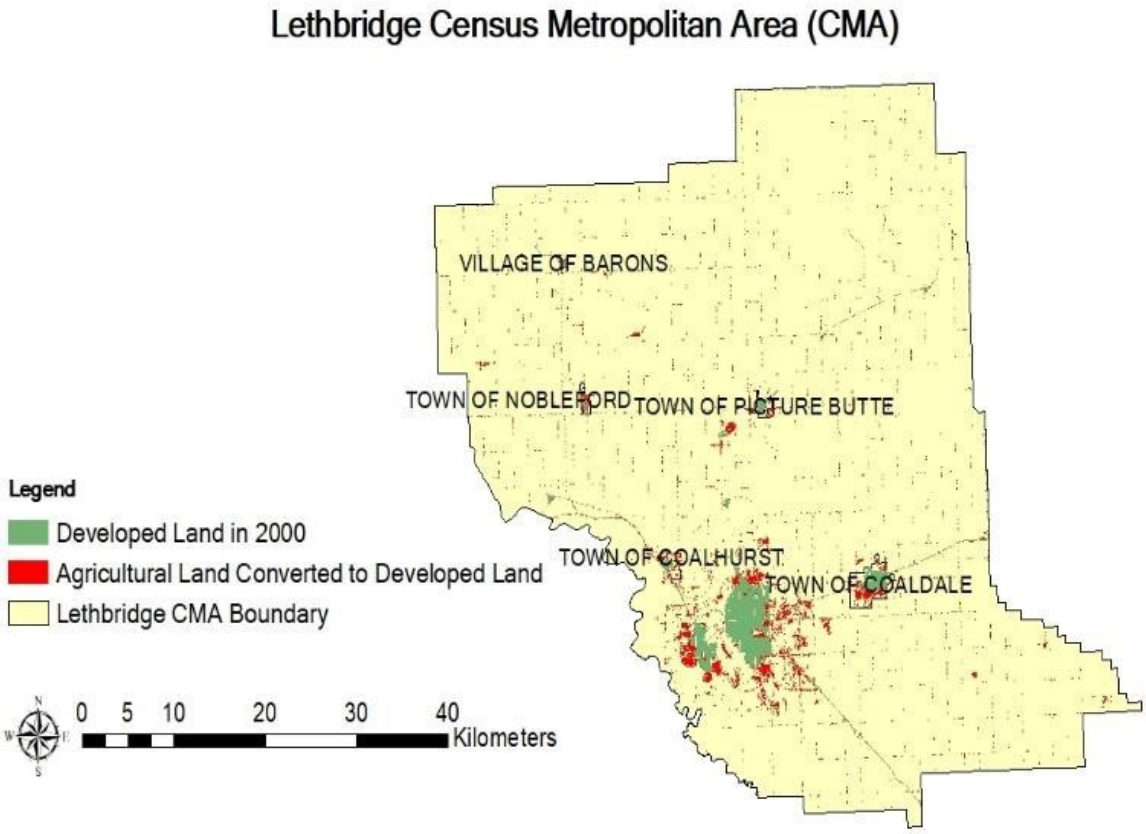


Figure 1.5 2000-2016 Development Trend Continues in Lethbridge CMA (Source: author's analysis of crop inventory data from Agriculture and Agrifood Canada)

Figure 1.5 displays the development trend of agricultural land in the Lethbridge Census metropolitan area from 2000 to 2016. Developed land increased by 16,579 acres, a 113% increase. Approximately 93% of the newly developed land was converted from agriculture. This represented a 2.5% reduction in agricultural land in the CMA.

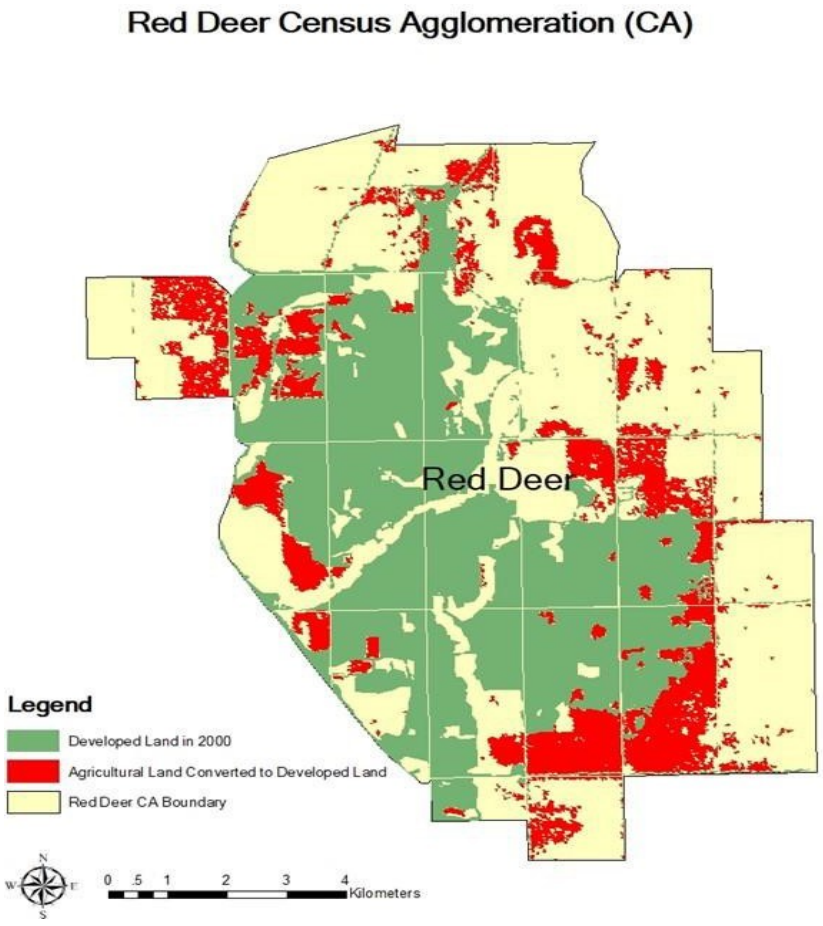


Figure 1.6 2000-2016 Development Trend Continues in Red Deer CA (Source: author's analysis of crop inventory data from Agriculture and Agrifood Canada)

Figure 1.6 displays the development trend of agricultural land in the Red Deer Census Agglomeration area from 2000 to 2016. Developed land increased by 5,309 acres, a 55% increase. Approximately 75% of the newly developed land was converted from agriculture. This represented a 35% reduction in agricultural land in the CA.

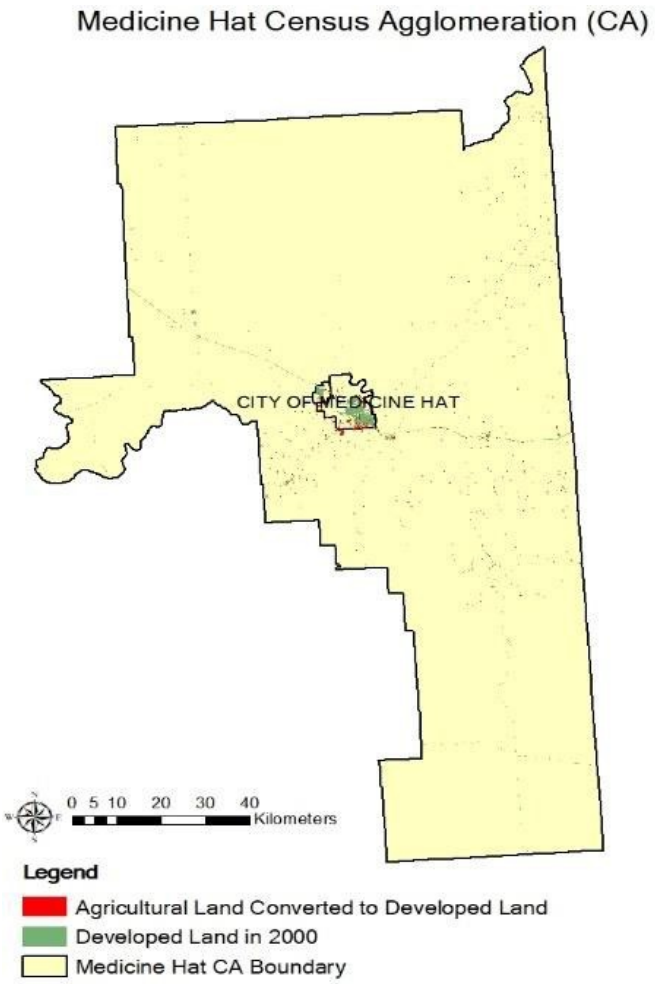


Figure 1.7 2000-2016 Development Trend Continues in Medicine Hat CA (Source: author's analysis of crop inventory data from Agriculture and Agrifood Canada)

Figure 1.7 displays the development trend of agricultural land in the Medicine Hat Census Agglomeration area from 2000 to 2016. Developed land increased by 15,238 acres, a 102.1% increase. Approximately 46% of the newly developed land was converted from agriculture. This represented a 0.87% reduction in agricultural land in the CA.

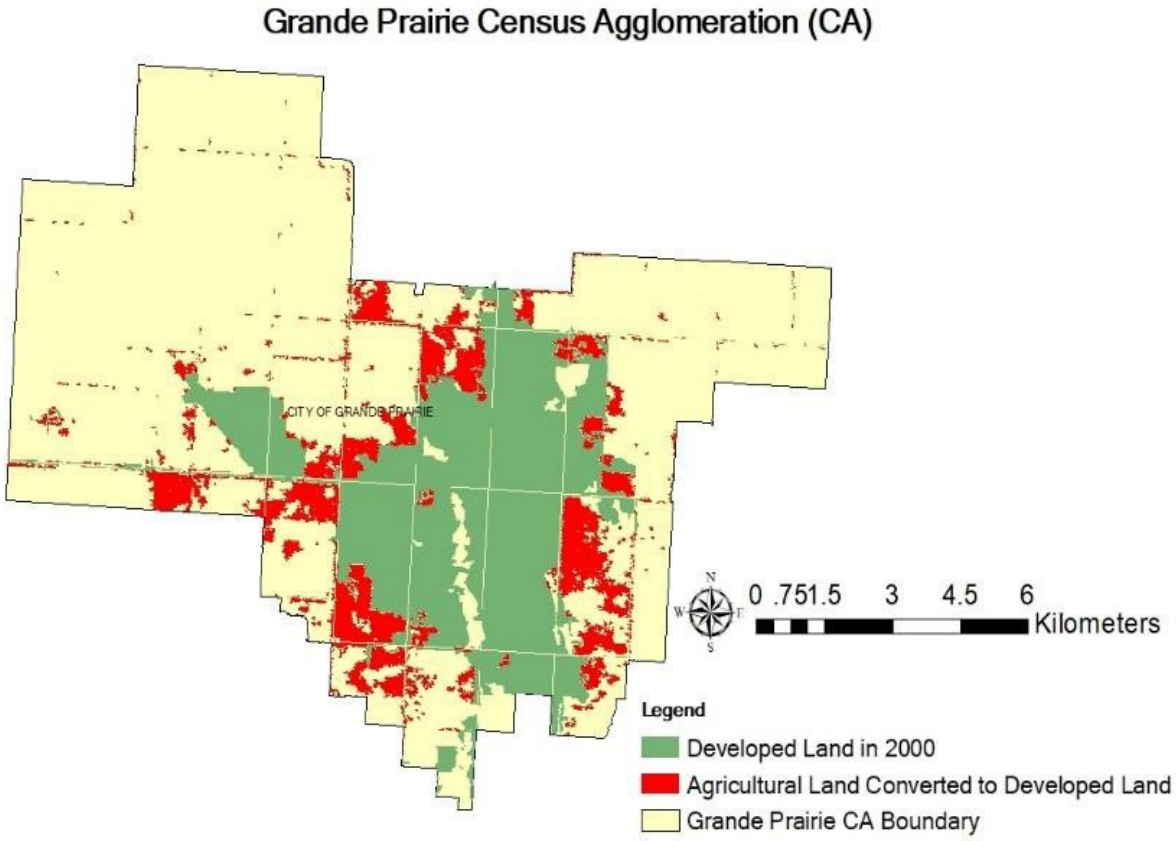


Figure 1.8 2000-2016 Development Trend Continues in Grande Prairie CA (Source: authors analysis of crop inventory data from Agriculture and Agrifood Canada)

Figure 1.8 displays the development trend of agricultural land in the Grande Prairie census agglomeration area from 2000 to 2016. The green shaded areas were developed as of 2000; the red shaded areas were converted from agriculture to developed uses between 2000 and 2016. Developed land increased by 3,607 acres, a 45.9% increase. Approximately 94.5% of the newly developed land was converted from agriculture. This represented a 16.1% reduction in agricultural land in the CA.

In summary, Alberta's 6 most populous urban areas experienced a total increase in urban uses of 241,905 acres between 2011 and 2016, approximately 53 percent of which occurred in the Edmonton metropolitan region, and 30% of which occurred in the Calgary metropolitan region. Nonetheless, the amount of farmland in the surrounding areas is still large. As economic development continues, there is still great potential for the remaining farmland in these areas to be converted. In addition, these six areas comprise around 72% of Alberta's total population. These six study areas thus represent most of the area that will be impacted by development or conservation policies.

1.3. Research objectives

As noted above, so far, Alberta has no specific policy or program to protect agricultural land. Provincial policies encourage municipal governments to protect prime agricultural land when considering specific applications to re-zone land. However, those municipalities often don't have good information on which to base their decisions. Municipalities are not required to keep track of past changes in permitted land use and often aren't aware of changes in actual land use. Losses of public good benefits of agricultural land can thus accumulate with little notice, while rezoning decisions are made on a case-by-case basis. Therefore, the general objective of this study is to inform decision makers about the values that gained or lost when land is converted from agriculture to other uses. This information will allow those decision makers to better identify the public interest in limiting private land rights, better complying with the Alberta Land Stewardship Act described above.

The specific objectives of this study are to:

1. Assess residents' willingness-to-pay (WTP) to conserve land in agricultural uses.

2. Assess residents' willingness-to-accept (WTA) compensation for the loss of nearby agricultural land due to light industrial, residential or retail development.

3. Identify and quantify differences in WTP and WTA as a contribution to both policy and methodology.

1.4. Thesis structure

There are five chapters in this thesis. Chapter 1 introduces the background and research objectives. Chapter 2 describes key conceptual issues, including the conceptual basis of the random utility model. Chapter 3 reviews the experimental design and how the choice experiment was undertaken to estimate nonmarket values. In particular, Chapter 3 covers the decision problem, the scenario attributes and levels, the experimental design and questionnaire, and the data collection process. Chapter 4 presents results from the analysis and compares the WTP and WTA results. Chapter 5 concludes the thesis, discusses the possible policy implications, identifies limitations of the study, and provides suggestions for future research.

Chapter2. Concepts and Research Methods

2.1. Introduction

This chapter reviews and summarizes the theoretical framework and conceptual models used to analyze choice experiment data. The Coase theorem, and its implications for property rights, is reviewed to illustrate how we relate our study to economic theory. Then different choice experiment methods and welfare estimation methods are reviewed. In addition, the random utility theory, Multinomial Logit, Random Parameter Logit and Latent Class models are introduced.

2.2. Coase Theorem and Land Policies

The "First" Coase Theorem is also called the "invariant theorem", which is named after Ronald Coase and identified by George Stigler. This theorem states that if private exchange of property rights can be undertaken with zero transaction cost, and property rights are initially assigned clearly, then resource allocation will not be affected by the initial assignment of property rights. An implication of this theorem is that governments concerned with externalities should focus more attention on the conditions for efficient markets than on redistribution of resources. To illustrate this principle, Coase (1960) gives an example of conflict between a cattle farm and an adjoining wheat farm. A herd of cattle goes into a wheat farm and eats the crops, what should be done? Two scenarios are discussed: (1) the cattle raiser is responsible to pay the wheat farm owner the full value of the damages or (2) cattle raiser does not need to pay any damages. These scenarios can be equated to property rights regimes. In the first regime, the cattle farmer has no right to do harm to the wheat farm, therefore, the wheat farm owner suffers because of the damage to the wheat. In the second regime, the wheat farmer has no right to force cattle to leave his farmland, thus the cattle raiser suffers interference from the wheat farm owner. In conclusion, to solve this externality

problem, it is essential to define initial legal rights very clearly, then let the market work. The "Second Coase Theorem" suggests that resource use will be Pareto-efficient under the same assumptions as the "First" Coase Theorem. The "Third" Coase Theorem is identified by Cheung (1990), based on Coase's (1959) book. This theorem states that "the delimitation of rights is an essential prelude to market transactions" (Coase 1988).

The three Coase theorems posit an economy that has zero transaction costs. The concept of transaction cost is elaborated by many papers (Webster, 1998; Dawkins, 2000; Staley, 2001). In reality, transaction costs cannot be zero because there is neither perfect rationality nor totally complete information as assumed in the Coase scenarios. Lai (1994) defines transaction costs as all costs other than the costs of physical production. Buitelaar (2004) suggested that there are two types of transaction costs. The cost (time, effort or money) to get information about a product is information cost. For instance, the costs of research into land use preferences can be considered a transaction cost. Another type of transaction cost is institutional costs. Institutions set up the rules of a society and reduce uncertainty. In a case of land property, it represents the rights and duties associated with a particular parcel of land. Institutional costs merge when institutions are created or changed. The Coase Theorem does not hold in the presence of positive transaction costs.

Loss aversion and the endowment effect further imply that costless trades are impossible. Kahneman and Tversky (1979) define loss aversion as people's tendency to prefer avoiding losses over gaining the same amount as a benefit. Therefore, people get different value from obtaining or receiving the same item, with the difference a cost of the transaction. Kahneman, Knetsch and Thaler (1990) use loss aversion to explain the endowment effect: people place higher value on a good they have than on a good they do not have. In our study, if the public has no right to the

benefits provided by open space (or farm owners have unlimited rights to convert farmland), then the public should pay farm owners to protect the land from being converted from agriculture to other uses. On the other hand, if the public has unlimited rights to the benefits of open space, then a developer who wants to convert the land should pay the public to compensate for the public's loss of open space benefits. Either of these payments would likely involve significant transaction costs. As described above, both the private rights of farmers and the rights of the general public are limited in the Alberta context.

2.3. Stated Preference Methods

2.3.1. Introduction of Stated Preference Methods (SP)

Private goods and services in a free market are bought and sold for prices, thus their value can be directly observed. Most environmental goods or services like clean air, open space, water and wildlife populations are not traded in markets, therefore they do not have observable monetary values. To avoid undervaluing these non-market values and reflect their true value to society, researchers use two main approaches: Revealed Preference Methods (RP) and Stated Preference Methods (SP). Most RP methods are based on statistical models of demand estimated on the basis of observations on the actual decisions that people make. The data on RP come from 'actual situations', while the data used in SP studies relies on 'hypothetical decisions' provided by survey respondents. Therefore, RP can reflect actual preferences and avoid potential problems associated with hypothetical responses such as strategic positioning. From a practical perspective, the main differences between revealed preference and stated preference methods is that they use different data (Johnston et al., 2017).

The first known basic conceptual framework for SP methods was provided by Thurstone (1927) and Ciriacy-Wantrup (1947) who first proposed the idea of valuing non-market items by asking people questions. Davis (1963) was the first to use the contingent valuation method and Luce and Tukey (1964) proposed the simultaneous conjoint measurement which is fundamental for the choice experiment method. Lancaster (1966) clarified the theoretical foundations for SP and showed that consumers value bundles of attributes of good and services. In the 1970s the main empirical applications of SP were in the marketing literature (Green & Rao, 1971; Green & Srinivasan, 1978). Bishop and Heberlein (1979) demonstrated the credibility of SP methods by comparing SP estimates with actual case payments.

SP methods were increasingly used in the 1980s and 1990s, with key contributions by Cummings et al. (1986) and Mitchell & Carson (1989). McFadden (1986) used econometric tools for discrete choice analysis to analyze choice-based conjoint elicitations in marketing and Lareau and Rae (1989) were the first to extend this analysis to the study of environmental economics.

Intense debate over the validity of SP methods arose in the case of damage assessment for the Exxon Valdez oil spill in the United States in 1989 (Carson et al., 2003). Some papers showed that SP methods do not always provide reliable information on individuals' preferences due to hypothetical bias (Carson, 2012; Hausman, 2012; Kling et al., 2012). An expert panel was established and led to the NOAA Panel Report on Contingent Valuation (Arrow et al., 1993) to investigate the validity of SP methods. More than 7,500 SP studies were published by 2011 (Carson, 2011; Kling et al., 2012). Choice experiments were widely applied in the environmental and health fields in the 1990s (Adamowicz et al., 1994; Adamowicz et al., 1998; Boxall et al., 1996; Hanley et al., 1998; Ryan, 1999), and several books about SP methods were published in

2000s (Louviere et al., 2000; Bennett & Blamey, 2001; Batemanet al., 2002; Champ et al., 2003; Kanninen, 2006; Ryan et al, 2008), along with articles summarizing the application of SP methods in different areas of inquiry (Boxall et al., 1996; Carson, 2000; Hanley et al., 2001; Ryan & Gerard, 2003; Carson & Hanemann, 2005; Hoyos, 2010; de Bekker-Grob et al., 2012).

SP studies were applied in broad fields: natural resource damage assessments, policy analyses, decision making by firms or NGOs, to name a few. Nowadays, SP methods are one of the most popular measurement tools in the valuation of changes in environmental goods, transportation, health effects and other applications (Mitchell & Carson, 1989; Bonnieux & Rainelli, 1999). In 1989 the US Court of Appeals announced that CV estimates of 'option and existence values' could be included as compensable values.

2.3.2. Contingent Valuation

Two main methods of stated preference are often distinguished: Contingent Valuation Method (CVM) and Discrete Choice Experiment (DCE or simply CE). CVM is a method in which survey respondents are asked their willingness to trade off money for the offered public good in a given scenario. CE is a particular type of contingent valuation that provides respondents with a set of choice sets and alternatives, which are constructed from experimental designs, and asks them to choose their preferred alternative (Parsons, 2003). The CVM method has some disadvantages: (1) the bid and payment scenarios are hypothetical; (2) it needs surveys to collect primary data through contact with respondents; (3) it may contain the risk of strategic behavior; (4) it requires advanced econometric methods to analyze data; and (5) presenting appropriate information in a survey is a significant challenge.

2.3.3. Choice Experiments

Choice experiments are now used more frequently than other contingent valuation methods. Survey respondents are required to indicate their preference among bundles of attributes of a public good or a policy. After multiple replications of these choice scenarios with respondents, information on tradeoffs between attributes, and overall demand for the good, can be determined. Individuals' willingness to pay (WTP) and willingness to accept (WTA) can be estimated from survey data.

The Hedonic Method provides the conceptual foundation for CE methods, which relates the demand for attributes to the demand for goods. Court (1939) initially used this approach to study the demand for automobiles. A new measurement technique which regards overall judgements as the sum of weights on a bundle of attributes of the alternative was proposed by Lancaster (1966). Green and Rao (1971) emphasized the important role of commodity attributes in the design of a new product. McFadden (1974) used discrete choice theory to predict choices in a marketplace. By combining random utility model (Marschak, 1960) and hedonic analysis of alternatives, McFadden (1974) developed the multinomial logit model.

CEs have been applied to a range of fields, such as health policy, planning and resource allocation decisions in high-income settings. These include the elicitation of views on diagnosis, treatment and care (Coast et al., 2006), access to services (Gerard et al., 2006) and the employment preferences of health personnel (Wordsworth et al., 2004).

The application of CE methods for environmental valuation can be traced to Rae (1983) who used rankings to value visible damage to US National Parks. Smith and Desvousges (1986) also used rankings to assess changes in water quality. Except for rankings, ratings methods were extensively

applied in environmental valuation (Mackenzie, 1993; Roe et al., 29916). However, neither ranking nor rating methods generate responses consistent with economic theory (Louviere et al., 2010). Therefore, these two methods gradually disappeared in the early 1990s as choice experiments came to the fore. Adamowicz et al. (1994) combined revealed and stated-preference data and CE methods have since been widely used.

Discussions about the advantages of CE have been presented by several authors (e.g. Swait and Adamowicz, 2001; Bennett, 1996; Hanley et al., 1998b). The CE method can identify how respondents make tradeoffs between attributes. It allows the analyst to calculate the marginal value of changes in every attribute as long as a monetary attribute is included (Adamowicz and Boxall, 2001).

Compared with other valuation methods, CE has following advantages (Holmes et al., 2017):

(a) CE provides values for changes in single characteristics and for different levels of characteristics. It not only allows for the valuation of a good, service and policy but also its attributes. Analysts using CE can think about trade-offs and examine individuals' preferences completely.

(b) It can test some of the properties of utility theory (such as transitivity) and provide marginal values which cannot be obtained from other preference elicitation techniques.

(c) It has been widely used in different disciplines, including environmental economics, transportation, marketing, and health economics.

(d) The experiment design theory used in CE leads to more statistically efficient parameter estimates so that smaller samples and implementation costs are needed in a project.

(e) Respondents are familiar with the question format and choices which are like the situations that consumers face in markets.

Although CE methods offer several advantages, there remain some potential challenges or disadvantages:

(a) When respondents consider alternatives in a choice set question, they were required to think about difficult tradeoffs between multiple attributes. Sometimes, they do not sufficiently understand the scenario or use decision heuristics to cope with the complexity. Attributes must be understandable and technically feasible.

(b) Similar to other techniques, CE methods also require a lot of information to be provided.

(c) Econometric analysis of cross‐section, time‐series data, and other complex or discrete choice data can be challenging. Advanced econometric and programming skills are required to operationalize.

(d) Although CE methods adopt statistically efficient designs, the experimental design theory is complex and thus advanced experimental design techniques are required.

(e) It is a stated preference technique; hence, issues of strategic behavior or hypothetical bias, and incentive compatibility or consequentiality problems may arise.

2.4. Measurement of Willingness to pay and Willingness to Accept

A report of the NOAA Blue Ribbon Panel (1993), a best practice guideline for estimating value, indicated that the willingness to pay format is better than the willingness to accept format. Thus, WTP has been much more widely used. According to the Environmental Valuation Reference Inventory (EVRI) database, the number of WTP studies is 14 times greater than the number of WTA studies. Haab and McConnell (2002) suggested that WTA responses lack incentive

compatibility. In addition, WTA responses can be unreliable due to scenario rejection, protest voting, endowment effects, and hypothetical bias (Villanueva et al., 2017). However, WTP estimation also has some of these disadvantages, and the WTA method is more appropriate than WTP method in some policy contexts (Knetsch, 2007). Lloyd-Smith & Adamowicz (2018) confirmed the validity of WTA through both public and private goods experiments. They extended the mechanism of incentive compatibility which is used in the WTP format (Vossler et al., 2012) to the WTA format.

Many studies have found differences between WTP and WTA estimates in practice. Tuncel and Hammitt (2014) summarized 76 studies which demonstrated the consistent gap between WTP and WTA. Kahneman and Tversky (1979) used the value function instead of a utility function to evaluate the marginal utility with a change of income. The result showed that people are more averse to a loss than attracted to a gain. This is described in section 2.2 as loss aversion. Also, several papers indicate that loss aversion could differ by some demographic factors like gender, education, income, and even culture (Booij & van de Kuilen, 2009; Booij et al., 2010; Wang et al., 2017). Therefore, WTP values are generally lower than WTA values. Knetsch and Sinden (1984) exhibited the disparity between willingness to accept (WTA) and willingness to pay (WTP) and showed that WTP may be under-perceived and WTA may be over-perceived. Theoretical explanations for the gap include: (1) income effect (Willig, 1976); (2) substitution effect (Hanemann, 1991); and (3) commitment costs (Corrigan et al., 2007). Due to the gap between WTP and WTA, values of WTP should not be used as proxies for WTA (Interis, 2014).

However, some studies have also found no significant disparity between WTP and WTA measures. List (2011) shows there is no gap between WTP and WTA for people who have market experience.

Relatively few studies have used choice experiments to estimate and compare WTP and WTA values. This study thus addresses the following challenges. First, what are the nonmarket values for farmland conserving and farmland converting to developed uses? Second, what is the difference between the two values and how do those values relate to policy?

2.5. Methodology

2.5.1. Theoretical Foundation for Random Utility Model

The framework for welfare analysis in choice experiments is the random utility model as initially proposed and applied by McFadden (1974). Hanemann (1978) was the first to use the random utility model to place values on environmental and natural resources. The neoclassical model considers consumption decisions as a problem of allocating a fixed budget to purchase a bundle of commodities to maximize utility over a limited time period. In the random utility model, a decision maker chooses one option from a set of alternatives and the researcher observes the choice and attributes of the option. The random utility model includes a stochastic term and combines randomness and behavior so that researchers can formulate hypotheses about the probability that an alternative is chosen as a function of observable components.

To better illustrate the random utility model, we begin with the indirect utility function. Suppose that individual *k* needs to choose one choice among *i* alternatives (*i*= 1 . . . N). Individual *k* knows their own utility function, but a researcher only has knowledge of systematic factors that affect utility. The indirect utility function for individual *k* is thus comprised of the sum of systematic (*v*) factors and random (ε) components:

$$V_{ik} = v_{ik}(Z_i, y_k - p_i) + \varepsilon_{ik} \quad (1)$$

Where V_{ik} is true but unobservable indirect utility of alternative i selected by individual k, Z_i is the vector of attributes with alternative i, y_k is the income for individual k, p_i is the cost of alternative i, and ε_{ik} is a random error term with zero mean.

When individuals make a choice among N mutually exclusive alternatives, it is assumed that they know their utility perfectly, so they will maximize utility. Therefore, individual k will choose alternative i among a set of all alternatives C in the choice set if and only if:

$$v_{ik}(\boldsymbol{Z_i}, y_k - p_i) + \varepsilon_{ik} > v_{jk}(\boldsymbol{Z_j}, y_k - p_j) + \varepsilon_{jk}; \forall\, j \in \mathrm{C} \quad (2)$$

The random utility model predicts the probability that an alternative was chosen given its systematic and error components. The general form for the probability that individual k choses alternative i from a choice set is:

$$P_{ik} = P[v_{ik}(\boldsymbol{Z_i}, y_k - p_i) + \varepsilon_{ik} > v_{jk}(\boldsymbol{Z_j}, y_k - p_j) + \varepsilon_{jk}; \forall\, j \in \mathrm{C}] \quad (3)$$

To identify the specification of the random utility function, we begin with the function of v_{ik}. We assume that v_{ik} is a linear function:

$$v_{ik} = \boldsymbol{\beta Z_i} + \lambda\,(y_k - p_i) + \varepsilon_{ik} \quad (4)$$

$\boldsymbol{\beta}$ is the vector of preference parameters for non-monetary attributes and λ represents the marginal utility of money.

2.5.2. Multinomial Logit Model

The standard assumption of the random utility model is that errors are independently and identically distributed (IID) following a type 1 extreme value distribution. A multinomial logit (MNL) or conditional model comes from a logistic distribution which was derived from the

difference between two Gumbel distributions (McFadden, 1974). Suppose there are N alternatives (i,j,= 1,…, N) and *K* respondents. If errors are distributed as type I extreme value, the probability of respondent *k* choosing alternative *i* in MNL model is expressed as:

$$P_{ik} = \frac{\exp\ (\mu v_{ik})}{\sum_{j=1}^{N} \exp\ (\mu v_{jk})} \quad (5)$$

Where μ is the scale parameter which represents the variance of the unobserved part of utility and equals one in basic models. MNL adopts the maximum likelihood estimation and the parameter of an attribute represents the marginal utility of this attribute (Ben-Akiva and Lerman 1985).

To simplify the econometric analysis of the MNL model, we assume that: (1) every participant has the identical preference structure so that β's are the same for everyone; and (2) the ratio of choice probabilities between any two alternatives does not affect other alternatives in the choice set. Therefore, this property (independence of irrelevant alternatives, IIA) leads to limited substitution possibilities. MNL assumes homogeneous preferences among consumers, although we know that consumer preferences for goods and services tend to be heterogeneous. Train (2003) suggests that ignoring the presence of heterogeneity may lead to biased estimates of attributes and erroneous welfare measurements.

To relax the assumptions of MNL and examine the heterogeneity in random utility models, three modifications have been suggested: (1) including interaction effects, (2) using a latent class model, and (3) using a random parameter mixed logit (RPL) model (Ben-Akiva and Lerman 1985; Louviere et al. 2000).

2.5.3. Interaction effects

Some respondents' characteristics like age, income, gender and other specific variables do not change across alternatives; therefore, the effects of these variables cannot be identified in a conditional logit model. To gain the information about heterogeneity of respondents, Adamowicz et al. (1997) interacted individual-specific variables with other attributes in order to identify attribute parameter differences. For example, we can generate an interaction term like male*price and estimate the marginal utility of money as a function of gender. The potential challenge of this method is that it may lead to a large number of interaction effects and high degrees of collinearity. Also, it requires a priori selection of the individual characteristic variables (Boxall and Adamowicz, 2002).

2.5.4. Latent Class Model

In a latent class model, it is assumed that respondents are segmented into different preference classes. MacFadden (1986) initiated consideration of latent constructs in a recreation demand choice model. Boxall and Adamowicz (2002) used the latent class model in analysis of choice experiment data. Suppose there are S segments in the population, the indirect utility function can be expressed as:

$$V_{ik|s} = \boldsymbol{\beta_s Z_i} + \varepsilon_{ik|s} \tag{6}$$

Where Vik|s is indirect utility of individual k, who belongs to segment s for alternative i, β_s are segment-specific utility parameters, $\boldsymbol{Z_i}$ is a vector of attributes of alternative i, individual *k* has a possibility of belonging to segment *s* (s = 1,…, S). Therefore, the probability of choosing alternative *i* depends on the segment that individual *k* belongs to is expressed as (Holmes et al., 2017):

$$P_{ik|s} = \frac{\exp(\beta_s Z_i)}{\sum_{k=1}^{N} \exp(\beta_s Z_k)} \quad (7)$$

Where β_s is the segment-specific utility estimates

The challenge of using the latent class model is to determine the appropriate number of classes (S). This choice is usually made on the basis of information criteria (Scarpa & Thiene, 2005) and the stability of the parameter estimates.

2.5.5. Random Parameter Logit Model

Another model which can be used to identify individual heterogeneity is the Random Parameter Logit (RPL) model (Train, 1998). The RPL model is based on the assumption that parameters are randomly distributed in the population so that heterogeneity can be captured by estimating the mean and variance of the random parameter distributions. Based on this assumption, the utility function can be expressed as:

$$v_{ik} = \boldsymbol{\beta} \boldsymbol{Z_i} + \varepsilon_{ik} = \bar{\boldsymbol{\beta}} \boldsymbol{i} + \tilde{\boldsymbol{\beta}} \boldsymbol{Z} \; \boldsymbol{i} + \varepsilon_{ik} \quad (8)$$

Where Z_i represents a vector of attributes which includes a monetary attribute. $\boldsymbol{\beta}$ represents the individual's parameter vector and is the sum of the population mean $\bar{\boldsymbol{\beta}}$ and an individual deviation $\tilde{\beta}_k \varepsilon_{ik}$ is the stochastic part of utility and is correlated among alternatives and is assumed to be a IID type I extreme value. Suppose $\boldsymbol{\beta}$ vary with a density distribution $f(\beta|\, \theta)$ and θ is a vector of underlying parameters (Holmes et al., 2017). The conditional probability of individual k choosing alternative i is expressed as:

$$P_{ik|\beta} = \frac{\exp(\beta Z_i)}{\sum_{j=1}^{N} \exp(\beta Z_j)} \quad (9)$$

Although RPL can capture the unobserved variables explicitly, it cannot reveal the sources of heterogeneity unless interaction terms are included.

2.5.6. Welfare Measures

To explain consumer welfare in the random utility model, we begin with a discussion of compensating variation. *CV* is the amount of money taken from income that returns people to their original utility after a change in *q* has occurred. In the case of a positive economic change, *CV* is the maximum amount of money people are willing to pay to have the economic change happen. The CV for a change in attribute levels from initial conditions (Z^0) to alternative conditions (Z^1) is given by Equation (10):

$$\mathrm{CV} = \frac{1}{\lambda}\{V^1 - V^0\} \tag{10}$$

Where V^1 and V^0 represent the indirect utility of new and initial strategy (state-of-the world state), respectively.

$$V^0 = \ (y_k, 0) \tag{11}$$

$$V^1 = \ (y_k - p_i, 1) \tag{12}$$

The '*1*' in equation (12) represents a specific new strategy. There is no change or new program without cost in the initial strategy, so we use '*0*' to represent this baseline. Suppose we have three attributes; we can estimate the utility function as a linear model in equation (13):

$$v_{ik} \ = \ \beta_1 Z_{i1} \ + \beta_2 Z_{i2} + \lambda \ (y_k - p_i) \ + \ \varepsilon_{ik} \tag{13}$$

Choice experiment methods are consistent with utility maximization and demand theory (Bateman et al., 2002), therefore, the marginal value of change in an attribute in a linear utility function is:

$$\mathrm{MRS}_i = -\frac{\partial v_{ik}/\partial z_i}{\partial v_{ik}/\partial y_k} = -1 * \left(\frac{\beta_{attribute}}{\beta_{monetrayvariable}}\right) = MWTP_i = MWTA_i \quad (14)$$

This formula shows that the marginal rate of substitution between the attribute in a survey and the marginal utility of money. It also represents the marginal welfare measure (willingness to pay or willingness to accept) for a change of an attribute in a linear model. Equation (14) shows that we can measure WTP or WTA in a random utility model. But, as shown in the next chapter, the study design and framing of the survey questions can matter a great deal to the reliability of these measures.

Chapter3. Methods for assessing willingness to pay for farmland conservation and willingness to accept compensation for farmland conversion

3.1. Introduction

This chapter explains the procedures followed to assess WTP for farmland conservation and WTA for farmland conversion in the Alberta study areas. The central method is a pair of choice experiment surveys implemented online with 1,303 complete responses. The WTP and WTA surveys were implemented at the same time, with the same respondent panels, with each respondent answering either the WTP or WTA versions of the survey. Here we describe the attributes, attribute levels, alternative identification, experimental design, questionnaire development, focus groups, pretest and soft launch, final launch and data collection, data interpretation and econometric models. Assumptions about property rights are also described.

3.2. Choice Experiment

3.2.1. Attributes and Attribute Levels

The choice experiment method requires the construction and description of attributes and their levels, but it is challenging to decide which attributes and levels to include and which to hold constant across all scenarios. Discussing relevant attributes and levels with focus groups can be effective, although little is known about how focus groups respond to complex survey questions (Swait & Adamowicz, 2001). Focus groups may come up with long lists of attributes to be considered. Minimizing the number of attributes and levels can lead to decision scenarios that are easier for respondents to comprehend. Regarding the description of attributes and their levels, Schultz et al. (2012) suggest that three standards should be considered for attributes: measurability (attributes are quantifiable), interpretability (a non-scientist can understand attributes), and

comprehensiveness (all relevant attributes are described). Based on this guidance, this study used just three attributes. This simple construction reduced the number of attribute combinations and facilitated clear comparison of WTP and WTA results. For example, if there are 3 attributes in the scenario, and each attribute has three levels, the total number of combinations is 3^3=27. If we added one more attribute with three levels, the total number of combinations would increase to 3^4=81. For the farmland conservation questionnaire, the attributes are: type of current agricultural use, type of replacement urban development that would occur, and a one-time property tax or rent increase for next year only (Cdn$). For the farmland conversion questionnaire, we likewise consider the type of current agricultural use, the type of replacement urban development that would occur, and the one-time payment that would be made to compensate for the loss of open space values of the converted land.

After identifying these attributes, appropriate levels for each attribute were considered. Regarding the current agricultural land use, the dominant agricultural land uses in Alberta are cropland (primarily used for grain or oilseed production) and grassland (primarily used for livestock grazing) (Haarsma & Qiu, 2015). Near to the major urban areas and in the irrigation areas near Edmonton and in southern Alberta, there are smaller but important amounts of land used for commercial vegetable production (Wang & Swallow, 2016). Wang and Swallow (2016) considered four types of agricultural land in their study of WTP for farmland conservation in the Edmonton region: grain / oilseed farming, livestock grazing on native pasture, hay land, and commercial vegetable farm. We did not include hay land in this study, reasoning that most urban respondents would not be able to distinguish hayland from grassland. Hay land and grassland also represent similar investments by farmers and generate similar ecosystem services.

Three types of developed land uses were considered as levels of the replacement urban development: light industrial, retail and residential. These land uses roughly correspond to the residential, commercial and industrial land use zones of Edmonton's Zoning Bylaw 12800 (City of Edmonton, 2017) and Calgary's Land Use Bylaw 1P2007 (City of Calgary, 2008). The payment attribute is central to the determination of welfare measures, its range and levels should be set carefully so that WTA and WTP can be reliably estimated in the econometric model and is reasonable in policy and in the real world. Payment levels that are too high or too low may not be considered credible by the respondents and thus reduce the reliability of the survey results (Holmes et al., 2017).

In this study, we went through the following steps to ascertain the payment levels. First, we considered the Wang and Swallow (2016) study which used a range of one-time payments between $25 and $600. 83% of respondents were willing to pay a minimum of $25, 75% were willing to pay a minimum of $50, while 36% were willing to pay a minimum of $600. We wanted a somewhat higher maximum level in hopes of further limiting demand at the highest level. Second, we considered the results of a recent study by Yangzhe (2018) that showed that houses in the town of Okotoks, Alberta, that were located within 200 meters of developable pasture or forest lands were priced about $10,000 - $20,000 more than houses further away from pasture or forest. We took this as an extreme upper limit of the amount of WTP or WTA for our study. Third, we wanted to use the same payment range in the WTP and WTA surveys, hypothesizing from previous studies that we were likely to find WTA to consistently exceed WTP. Fourth, we wanted to limit the number of levels in order to simplify the number of design combinations. And finally, we wanted to ensure that respondents would find all alternatives credible and not lodge "protest votes". We

specifically asked our two focus groups (see below) to carefully consider and discuss the payment vehicle and range. Some focus group members stated that costs or payments under $500 would not warrant serious evaluation, while other focus group members stated that $1000 would be very difficult for them to afford, but that they might be willing to make such a payment to protect agricultural land. We thus concluded that our respondents would find the $50-$1000 range to be credible, thus producing the most reliable results.

In the stated preference method, there are two main kinds of payment vehicles: voluntary and coercive payments. Voluntary payments include donations to foundations, suggested donation amounts for visitors, membership fees in land trusts, and other non-binding payment methods. Voluntary payments encourage free-riding and may lead to overstated estimates of WTP and incentive incompatibility problems. Considering these disadvantages, we do not adopt voluntary payments in our survey. Coercive payments like taxes increase the credibility of the survey to respondents and ensure consequentiality. One challenge with a tax as a payment vehicle is that it excludes non-taxpayers, however most environmental programs are funded by taxpayers and the survey is targeted to Albertan residents who pay tax, so it meets our requirement. Taxpayers in Alberta had experience with receiving carbon levy rebates of $300-$630 per household in 2019, which resembles the WTA scenario. Edmonton and Calgary taxpayers are also accustomed to discussions of capital development levies that were (Edmonton) or could be (Calgary) added to property tax bills to finance specific infrastructure development projects, such as arenas. We wanted to include both homeowners and renters in our survey and thus our scenario was specified for a one-time increase in tax or rent. Renters might assume that the owners of apartment buildings

may choose to spread the payments over the year as increases in monthly rent, as is the case for other property taxes. Our focus groups concurred with this approach.

Table 3.1 Attributes and Attribute Levels

Attribute	Level	Explanation
Type of Current Agricultural Use	• Grain or Oilseed Farming • Livestock grazing on native pasture • Commercial Vegetable Farm	Major types of agriculture in your area.
Type of development without conservation	• Residential • Light Industrial • Retail	Major types of urban development without conservation in your area
One-time additional cost to each taxpayer ($)	• 50 • 100 • 300 • 600 • 1000	One-time additional increase in property tax or rent to each taxpayer in your area

Source: authors.

3.2.2. Alternative Identification

A fundamental issue that arises in choice experiment surveys is whether to use labeled alternatives in choice sets. The labeled form uses alternative-specific titles for the alternatives while the unlabeled form uses generic titles for the alternatives. Labeled alternatives can be described in term of attribute levels (e.g. travel by bus, train or air), and they convey information to respondents so that choice tasks become more realistic. However, respondents may infer information just by using labeled alternatives and sometimes even ignore the attributes presented in the choice set. The

inferences usually correlate with the random component (Louviere et al, 2000). Another drawback of using labeled alternatives is that it is necessary to estimate more parameters and thus a larger design with more degrees of freedom is required (Holmes et al, 2017). Assuming a labeled choice experiment has A attributes with L levels and M choice sets, then the total number of choice sets is L^{MA}, while the number of choice sets in an unlabeled choice experiment is only L^{A}., Also, alternatives should be uncorrelated in the model. A label treated as an attribute in the modelling process may lead to correlation between alternatives and attributes, thus failing to satisfy the IID assumption (independent and identically distributed) (Hensher et al, 2005). Therefore, unlabeled alternatives were adopted in this choice experiment. Each choice scenario presents two alternatives: a status quo and a conservation strategy for the WTP analysis, and a status quo and a development strategy for the WTA analysis. The status quo represents the current development trend in the study area, which was described to respondents as "some blend of denser and more expansionary development." Maps of the 2000-2016 development trend, shown in Chapter 1, were provided to the respondents, with each respondent only viewing the map that is relevant to their own area. Respondents to the WTP scenario were thus expected to assume that the 2000-2016 trend in land use change would continue as the status quo, with the conservation scenario involving the development of 1000 acres less than the current development trend. Likewise, respondents to the WTA scenario were expected to assume that the 2000-2016 trend in land use change would continue as the status quo, with the development scenario involving an additional 1000 acres of development. The additional area of development or additional area of conservation has the attributes described above. The WTP scenario implied that there was no limitation on the right to develop; the WTA scenario implied that there was no right to develop.

3.2.3. Experimental Design

Given the selected attributes and their levels, the allocation of these attribute levels to alternative choice sets is the fundamental problem in the experiment design for the choice experiment. Identification of the preference parameters requires sufficient independent variation among attribute levels. Also, the design should not only consider statistical efficiency with minimum standard errors of the preference parameter estimates, but also respondents' cognitive abilities and attention budgets. Selecting an efficient design is vitally important because different designs affect the parameter estimates and lead to different WTP and WTA results.

In the WTP study, each questionnaire provides the respondent with a choice of status quo (current development trend continues with no additional conservation or development) or the current development trend continues with an additional conservation program that is comprised of a set of attributes on farmland types conserved (3 levels), replacement developed land types (3 levels) and cost (5 levels). Therefore, there are 45 combinations in total (3*3*5=45). The full factorial experiment which includes all possible combinations of all levels of attributes is good for coverage of the attribute space so that all main and interaction effects are statistically independent; however, it means that there are fewer observations for each combination of attributes because of a constrained sample size (Hensher et al., 2005). In this study, there are observations for about 650 respondents for each survey, therefore we judged that there would be insufficient observations for accurate parameter estimates if the full factorial design was applied. To reduce the design size and select fewer choice sets, the fractional factorial design was used. However, this design may limit the main and interaction effects, and leads to statistical inefficiency. A good traditional orthogonal design can remove multicollinearity between attributes and minimize the variance of the parameter

estimates when the variance-covariance (VC) matrix is minimized. Orthogonal fractional factorial design ensures no correlation but may not be the most statistically efficient design. The efficient design can generate the most information but may have correlation. In this study, we chose an efficient design. An efficient design such as the 'd-optimal' design minimizes the inverse of the determinant of the variance-covariance matrix of the parameters (D-error). Optimal orthogonal design is one of the methods to find D-efficient designs for choice experiments (Rose & Bliemer, 2013). In this study, there is no prior data from a pilot study, therefore all alternatives contained in the choice sets were assumed to be equally attractive and preference parameters were assumed to equal zero.

The number of choice sets depends on the number of degrees of freedom and whether the alternatives are labeled or not. This study only included two alternatives for each scenario: status quo and strategy applied, and the unlabeled alternative was adopted. Under this circumstance, the number of choice sets should meet the requirement (J-1) * S> = K, where J is the number of alternatives, K is the number of parameters to be estimated, and S is the total number of choice sets in the design (Rose & Bliemer, 2013). In this study, there are two alternatives (status quo and conservation / development strategy) and 6 parameters in each questionnaire, therefore, for the following to hold -- (2-1) *S>=5 – S should be not less than 6. Assigning respondents to blocks can reduce the cognitive burden on each respondent. Therefore, each questionnaire in this survey was designed to consist of 16 different choice sets which were blocked into 2 sets of eight. Each respondent was required to answer one block of 8 questions. The Ngene software was used to do the D-efficiency design and blocking. The syntax for the D-efficient design in Ngene is available in the Appendix.

3.2.4. Questionnaire Development

There are different types of questionnaire formats for collecting data, such as mail out, mail-back surveys, telephone recruitment, computer-assisted surveys at centralized facilities, in-person and internet-based surveys (Holmes et al., 2003). Our survey provides respondents with complex sets of questions and provides verbal descriptions and visuals including maps and photographs (see the appendix). In order to engage respondents and give them more time to absorb sufficient information, we implemented this study as an internet-based survey to a panel of potential recruits.

The draft survey included four sets of questions: warm-up, choice experiment, debriefing / follow up, and demographic. Background information on agricultural land conversion in each of the six study areas was provided to help respondents get familiar with the scenarios covered in the survey. Respondents could choose to read the background information on the region where they currently reside before they completed the warm-up questions. Those warm-up questions were designed to elicit people's attitudes toward agricultural land use, urban growth and farmland conversion, development planning and types of future development.

In the choice experiment questions, each choice set was presented with attributes as the rows and alternatives as columns. Images for the type of agricultural use and possible replacement urban development were provided to help respondents understand the conservation or conversion scenarios. Although background information and detailed introduction of program can alleviate 'information bias', it is important to avoid persuasive communications which may mislead respondents' choices. Respondents sometimes are not sensitive to the quality or quantity of the good being offered. To avoid this insensitivity to magnitude, we told respondents that all of the proposed strategies would result in the protection or conversion of 1000 acres of farmland,

somewhere within 10 kilometers of current developed areas in their regions. A distance scale was provided for all of the maps. We chose this standard size and location partly in order to simplify the study design. The previous study by Wang and Swallow (2016) varied the size of the conservation area with little gain in insight.

Figure 3.1 is the example of a choice set for the farmland conservation survey. Respondents were assigned to one of the two blocks randomly and then were required to answer questions about the 8 different choice sets in that block. The red X over the photograph of residential land use represents that this conservation strategy would avoid farmland from being converted into residential uses. This representation of the avoidance of a land use change was discussed and approved by the focus groups. Respondents were told that the additional conservation or additional development would occur within 10km of current urban areas.

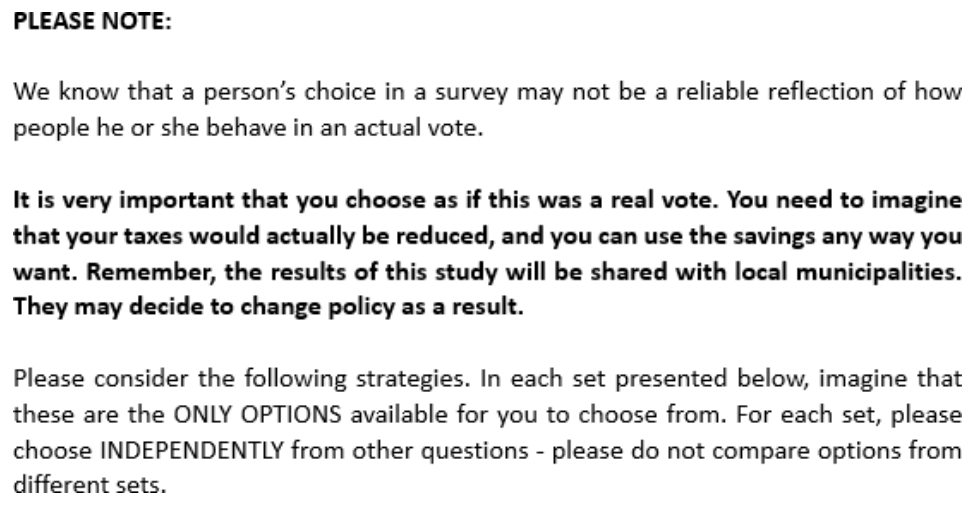
No additional conservation strategy
2000-2016 development trend continues

Additional Conservation Strategy		
Type of Current Agricultural Use	Type of urban development without conservation	One-time additional increase in property tax or rent to each taxpayer in your area ($)
Grain or Oilseed Farming 	Residential 	$50

Figure 3.1 Example of a Choice Set for the Conservation Survey

As discussed in Chapter 2**,** hypothetical bias (social desirability or strategic behavior) and incentive compatibility are among the most important issues to address in the design of a choice experiment. Three methods have been commonly used to eliminate the effect of hypothetical bias. The first is to use a 'cheap talk script' to increase validity of responses (Cummings and Taylor, 1999). Respondents are reminded that the hypothetical values in the questionnaire may be higher than they would be in reality. However, List (2001) showed that this approach can calibrate responses to 'real' choices, and Carlsson et al (2005) proved that the method affects respondents' decisions. Thus, we do not use this method in our study. The second method is to include uncertainty questions. That is, we ask respondents to indicate how certain they are about their decision if the scenario was an actual program. From the theory of loss aversion, we assumed that people are not willing to lose or pay money that they have if they are uncertain about the strategies. Therefore, in the WTP survey, respondents who indicated that they were certain or very certain were taken at their word, a response of yes was taken to be a yes, and a response of no was taken to be a no. If they indicated that they were not certain, then both yes and no responses were coded as no, assuming that people would be reluctant to pay or give up the opportunity to receive payment (Blumenschein et al., 2008). In the WTA survey, respondents who indicated that they were not certain about their responses were assumed to be over-stating their true WTA. Thus, both yes and no responses were coded as yes. To apply this method, we added a certainty question after each choice scenario question. Carson and Groves (2007) showed that participants care about how the results of a study affect their real lives. Thus, the third method is to describe to respondents that the program described in the questionnaire is consequential, that the strategy may actually be used in policy (Vossler et al., 2012). Figure 3.2 shows how we expressed consequentiality in our

surveys. Previous research by the authors has indeed been presented to a variety of policy makers and been availed through the media to the general public.



PLEASE NOTE:

We know that a person's choice in a survey may not be a reliable reflection of how people he or she behave in an actual vote.

It is very important that you choose as if this was a real vote. You need to imagine that your taxes would actually be reduced, and you can use the savings any way you want. Remember, the results of this study will be shared with local municipalities. They may decide to change policy as a result.

Please consider the following strategies. In each set presented below, imagine that these are the ONLY OPTIONS available for you to choose from. For each set, please choose INDEPENDENTLY from other questions - please do not compare options from different sets.

Figure 3.2 Example of a consequentiality reminder used in surveys (Source: authors)

Respondents may sometimes simply answer 'Yes' to bids or vote to choose a strategy because it 'feels good.' In order to avoid such 'warm glow' or 'yea-saying' responses, and to identify scenario rejecters and protest votes, follow-up questions are important and useful. An easy approach is to ask respondents the extent to which they believe that the strategy could actually be implemented and how important the attributes were to their decisions. We included such questions in the concluding section of our surveys. Section 4.5.3 summarizes the results of those questions.

3.2.5. Focus Groups

We convened two focus groups to ensure that the questions were clear and logical and that the background information was adequate and understandable. After reading the information sheet and

completing consent forms (see below), focus group participants were presented with a paper copy of the online survey and asked to complete the survey on their own. After all focus group members completed the survey, we posed questions regarding ease of comprehension, respondent fatigue, language and format, hypothetical bias tests, consequentiality test, and scope. After getting approval from the University of Alberta Human Ethics Review Board (Pro00085639_AME1), we recruited a local survey company, *Trend Research*, to recruit focus group participants. Before the focus group was held, *Trend Research* provided us with some summary information (age, gender and occupation) about the participants. We only knew the names of participants from the consent forms but were not able to relate this information to names. With *Trend Research*, we prepared a recruitment screening questionnaire and provided potential participants with background on the purpose of the study and the focus group. Focus group participants were each given $75 at the conclusion of the focus group.

Focus groups were convened in the Lethbridge CMA on 24 January 2019 and the Edmonton CMA on 31 January 2019. Focus group participants represented the major demographic strata of the jurisdiction (esp. age groups, gender). For the focus group, we intended to get equal numbers of men and women and to involve people over 18 years of age. Non-residents of the six urban areas are excluded since they do not pay taxes in the specific jurisdictions. Anyone who works for a municipal planning department was also ruled out. To make sure that at least 10 participants showed up, 12 participants were invited to each focus group. In both cases, all 12 of the invited participants appeared and participated actively in the focus groups.

Trend Research recruited respondents for the two focus groups from two main sources: their panel of over 40,000 Albertans and by random digit dial. Samples from their panel were drawn for the

Lethbridge and Edmonton CMA areas. Trend Research holds telephone numbers and email addresses for their panel members, all of whom have agreed to be contacted for public opinion surveys. The random digit dial sample is developed by randomly drawing numbers from all known exchanges (landline and cell) for a given area. Once panel and RDD sample have been developed they are put together in equal parts, then a random draw of potential focus group participants are contacted.

The Focus Group Recruiters at Trend Research were trained on the project, with the Qualitative Manager providing a thorough briefing to the recruiters. After the briefing, recruiters called potential respondents and went through the recruitment screener with them. Potential focus group participants were informed of the purpose of the research, the task being asked of them, the necessary time commitment and the financial incentive they would receive.

It is also important to note that respondents were told that participation in the focus group was not mandatory and that they had every right to not participate. If a respondent continued through a screener and "qualified," they were invited to participate. They were given the research particulars including the date, time and location of the Focus Group. The Manager then emailed the respondent a confirmation letter reiterating the information they had received over the phone. There was also a contact at *Trend Research* to speak with if they had any questions or needed to cancel. Two days prior to the dates scheduled for the focus groups, *Trend Research* conducted a confirmation call – reminding the respondent of the group and ensuring they had the necessary information. They were informed that they would be discussing issues related to conservation and development of land in agricultural uses, that the maximum time commitment was 2 hours, and that they would receive an honorarium of $75 if they participated.

At the focus group itself, participants were given an Information Sheet (Appendix B) and a Consent Form Checklist (Appendix C), which concluded the research background and objectives. The Consent Form Checklist concluded with a signature granting consent to participate. Half of the participants were given the WTP version of questionnaire and half were given the WTA version.

Participants were asked to complete the survey and given sufficient time. At both focus groups, the first participants completed within 20 minutes and the last completed within 35 minutes. The survey team then posed a series of open-ended questions for discussion and focus group members were encouraged to raise questions and discuss any concerns or difficulties that they had with the questionnaires. We went through the survey page by page to make sure we captured all comments. Focus group members also wrote comments on the questionnaire that they returned to the study team.

The two focus groups proved to be extremely helpful for finalizing the survey instrument and comments were very constructive**.** Some useful background information was provided by respondents. For example, one respondent proposed that land used for vegetable growing is typically higher quality than land used for other uses, often has had more investment by its owners, and thus could warrant higher compensation. Also, issues such as the format of questions, consequentiality, clarity of scenarios, and order of the questions were raised and discussed. For instance, panelists in the Lethbridge focus group were somewhat skeptical that the compensation strategy would be implemented and proposed that respondents might not read the scenarios carefully if they were too similar. As a result of the focus groups, we adopted some approaches to increase the credibility of the strategies and enhance consequentiality: (1) we provided more specific and complete information about the current development trends in the relevant study areas

to help respondents better understand the status quo and conservation / conversion scenarios; (2) we highlighted the payment vehicle and gave respondents clearer explanations of the payment or compensation mechanisms; (3) we randomized the order of some questions to minimize the default effect; and (4) we simplified the language as much as possible. We tested those approaches with the Edmonton focus group and specifically asked respondents about consequentiality. In addition, we modified some specific terminology and adjusted the format of questions to alleviate respondents' cognitive burden. Lastly, based on the feedback of the focus groups, we slightly adjusted the range of the cost/compensation attributes. Once the focus groups were completed, we placed the consent forms in a locked filing cabinet.

3.2.6. Pretest and Soft Launch

To test the internet version of the surveys, two questionnaires were assigned to 12 students and professors at the University of Alberta on 3rd March 2019. Each was asked to complete the online survey independently within 30 minutes. Participants were encouraged to point out any editorial mistakes or concerns about survey flow. The pre-test participants noted no specific barriers to answering the survey questions and no problem with the time limit. No additional adjustments were made.

Before surveys were sent out to the full sample of respondents, a soft launch was implemented to get some results for preliminary analysis. We used the Qualtrics survey design software to format the questionnaire for online presentation. Once we approved the online format, Qualtrics did a soft launch of the survey with 10% of the intended sample. A total of 60+60 (WTP+WTA) complete responses were gathered on 11st March 2019. Simple descriptive statistics from the soft launch data showed levels of payment and compensation to be in line with our expectations. We also ran

simple multinomial models for both WTP and WTA. This yielded a significant negative sign on cost for the WTP equation and significant positive sign on compensation for the WTA equation, which was consistent with our expectation. None of the agricultural or developed land use types were statistically significant. Therefore, only some very minor adjustments were implemented to improve the survey quality for the full launch.

3.2.7. Data Collection (Full Launch)

We negotiated with two survey companies and chose Qualtrics to solicit respondents to the online surveys. Qualtrics is an international company that specializes in survey management, data collection, and delivery. They work with two local partners to maintain panels of potential online survey respondents. Panelists receive merchant points for answering questionnaires. Merchant points are allocated to respondents who complete the questionnaire, with more points awarded for longer questionnaires. Qualtrics was requested to collect data based on a balance of gender, income levels and age representing the Alberta adult population. Qualtrics and their partners sent out a total of 42,000 invitations for WTP and 40,000 invitations for WTA. Once they received sufficient completed responses, they stopped the survey. Qualtrics implemented the survey with the full sample between 14th and 19th March 2019. 1,900 respondents entered the WTP survey and 1,750 respondents entered the WTA survey. Qualtrics implemented a data scrubbing process to remove responses that were incomplete or clearly insincere. Finally, a total of 643+660 (WTP+WTA) complete responses were regarded as the full valid sample. The survey completion rate was 33.84% for WTP survey and 37.71% for WTA survey. The ratios of complete responses solicited by the two local companies were similar for the WTP and WTA surveys: 6.5:10 for the WTP survey and 5.7:10 for the WTA survey.

The online survey involved a total of 1,303 complete respondents. Survey respondents represent a balance of the major demographic strata of the 6 study jurisdictions. For this survey, Qualtrics screened potential respondents according to three criteria that we provided. Residents should be actual or potential taxpayers and over the age of 18 years. Persons who are neither homeowners nor renters were excluded. We asked non-residents of the six urban areas to exclude themselves since they do not contribute to the tax base of those specific jurisdictions. This exclusion was intended to elicit more realistic willingness to pay and willingness to accept estimates from the survey, as residents might actually be presented with questions involving redirecting one-time additional tax reduction or tax increases. If they didn't meet requirements, they were screened out.

The survey was offered only in the English language, thus non-English speakers were excluded from participating in the online surveys.

To avoid respondent fatigue, skipping and display logic were adopted so that participants only needed to read the background information about their specific regions. To ensure that participants answered each question independently, participants were not allowed to go back to previous pages to compare or check options from different question sets. A trap question was designed to test that respondents were paying attention to their questions and read questionnaires carefully. Respondents who failed the trap question were also screened out. Considering the high sensitivity of asking questions about income, that question was asked last and respondents were allowed to avoid answering that question. All other questions were forced responses, requiring respondents to answer each question before moving to the next question. 28 responses from WTP survey and 13 responses from WTA survey were excluded from the analysis because their open-ended

answers indicated that they rejected the premise of the study. 34 WTP responses and 40 WTA responses were ruled out by the attention trap question.

3.2.8. Econometric Model

Following Chapter 2, the observable utility function for the empirical analysis is shown below:

$$V_{ik}(Z_i, y_k\text{-}p_i) =$$

$$\beta_0(ASC) + \beta_1(vegetable) + \beta_2(livestock) + \beta_3(retaill) + \beta_4(light\ industrial) + \beta_5(cost) \quad (15)$$

Where variables are defined as follows:

Table 3.2 Definitions of Attributes

attributes \ types	WTP	WTA
ASC	binary (0,1) variable indicating a baseline conservation strategy (avoid grain or oilseed land being used for residential)	binary (0,1) variable indicating a baseline conversion strategy (convert grain or oilseed land to residential use)
Vegetable	binary (0,1) variable indicating that commercial vegetable farm is conserved	binary (0,1) variable indicating that commercial vegetable farm is converted
Livestock	binary (0,1) variable indicating that livestock grazing land is conserved	binary (0,1) variable indicating that livestock grazing land is converted
Retail	binary (0,1) variable indicating that conserved land would otherwise be converted into retail	binary (0,1) variable indicating that land will be converted into retail use
light industrial	binary (0,1) variable indicating that conserved land	binary (0,1) variable indicating that land will be

	would otherwise be converted into light industrial use	converted into light industrial use
cost	One-time additional increase in property tax or rent to each taxpayer in a respondent's area ($)	One-time reduction in property tax or rent to each taxpayer in a respondent's area ($)

There are three attributes for type of agricultural lands. In order to avoid perfect multicollinearity, one attribute (grain) was omitted from the model. Similarly, residential was the type of developed land use that was omitted from the model.

Chapter4. Results

4.1. Introduction

This chapter introduces the results generated from the WTP and WTA studies in a sequence of steps. Firstly, respondents' demographic and socio-economic status from both surveys are summarized. Second, results from the warm-up questions regarding attitudes toward farmland conservation and development are presented. Next, data from the choice experiment questions of WTP and WTA are analyzed using three econometric models: multinomial logit (MNL), latent class model (LCM), and random parameter logit (RPL). Results for different sub-populations are presented. Estimates of marginal willingness to pay and marginal willingness to accept are calculated based on the result of the RPL models. Finally, MWTP and MWTA results are compared. A short summary concludes the chapter.

4.2. Demographic and Socio-economic Statistics

Table 4.1 summarizes demographic and socio-economic statistics for the respondents to the on-line surveys. More women than men completed the survey, particularly the WTP survey, although the survey company attempted to obtain a more equal balance of women and men. The survey company expressed difficulty in obtaining gender balance for the smaller cities where they have smaller panels. Eighty percent of the respondents are resident in either the Edmonton or Calgary regions, with 5.3% from the Lethbridge region, 5.1% from the Red Deer region, 3.3% from the Medicine Hat region, and 2.3% from the Grande Prairie region. Small numbers for the smaller cities limit the statistical power of our results for those areas. Over 70% of all respondents live in cities. The status of age, residence, living in city, education, income and ownership in both samples are very similar between the WTP and WTA surveys. For respondents who answered the WTP

survey (WTP respondents), the average age is around 46 with a maximum 82 and a minimum of 18 years old. For respondents who answered the WTA survey (WTA respondents), the average age is approximately 47 with a maximum of 92 and a minimum of 18 years old. The median household incomes for both WTA and WTP respondents are between $60,000 and $89,999. Around 70% of respondents own residences, 30% of respondents rent residences and 6% of respondents own agricultural lands. Each survey has around 41% of respondents with completed university undergraduate or post-graduate degrees. In terms of employment, 48% of WTP respondents have full-time jobs, while 44% of the WTA respondents have full-time jobs. A two-sample t-test is used to examine whether there exist statistically significant differences between WTP and WTA samples. The results show that there are statistically significant differences in participation by gender, with a higher proportion of women responding to the WTP than WTA surveys. Unfortunately, it is not possible for us to easily compare the characteristics of our samples with the broader Alberta population. The age range for our sample is over 18 years old, which is beyond the range of population for some demographic variables recorded by Statistics Canada.

Table 4.1 Demographic and Socio-economic Statistics for the Sample

（N=643 for WTP, N= 660 for WTA）

Demographic variables	Description	Frequency			Sample percentage (%)			
		WTP	WTA	Total	WTP	WTA	Significance[a]	Total
Gender	Male	246	305	551	38.26	46.21	***	42.29
	Female	396	355	751	61.59	53.79	***	57.64
	Other	1	0	1	0.16	0.00		0.08
Residence (region)	Edmonton	271	263	534	42.15	39.85		40.98
	Calgary	269	276	545	41.84	41.82		41.83
	Lethbridge	34	45	79	5.29	6.82		6.06
	Red Deer	33	32	65	5.13	4.85		4.99
	Medicine Hat	21	29	50	3.27	4.39		3.84
	Grande Prairie	15	15	30	2.33	2.27		2.30
	Less than $30,000	90	99	189	14.02	15.05		14.50
	$30,000 - $59,999	164	168	332	25.55	25.53		25.48
	$60,000 - $89,999	137	153	290	21.34	23.25		22.26
	$90,000 - $119,999	124	101	225	19.31	15.35	**	17.27

Household income (before tax)	$120,000 - $149,999	70	74	144	10.90	11.25		11.05
	Greater than $150,000	57	63	120	8.88	9.57		9.21
Education	Lower than high school	20	12	32	3.11	1.82		2.46
	Completed high school	146	175	321	22.71	26.52		24.64
	Completed post-secondary technical school	210	201	411	32.66	30.45		31.54
	Completed university undergraduate degree	210	205	415	32.66	31.06		31.85
	Completed post-graduate degree (e.g., Master or Ph.D.)	57	67	124	8.86	10.15		9.52
employment	Working part-time	110	95	205	17.11	14.39		15.73
	Working full-time	309	289	598	48.06	43.79		45.89
	Retired	112	160	272	17.42	24.24	**	20.87
	Student	25	29	54	3.89	4.39		4.14
	Unemployed	50	53	103	7.78	8.03		7.90
	Other, please specify	37	34	71	5.75	5.15		5.45
City	In a city	476	464	940	74.03	70.30		72.14
	Outside of a city	62	76	138	9.64	11.52		10.59
	Others, please specify	105	120	225	16.33	18.18		17.27
Ownership	Own residence	449	474	923	69.83	71.82		70.84
	Rent residence	192	196	388	29.86	29.70		29.78
	Own agricultural land	37	39	76	5.75	5.91		5.83
Age	18-64	554	538	1092	86.16	81.52		83.81
	65+	89	122	211	13.84	18.48		16.19

a. The significance of the differences between WTP and WTA samples gained from two-samples t-test. *** p<0.01, ** p<0.05, * p<0.1, no symbol represents no significant differences. (Source: authors)

4.3. Background Information Response

Respondents from two surveys were required to answer the same warm-up questions before they did the choice experiment questions. Therefore, this section combines results of the warm-up questions from the WTP and WTA surveys. Firstly, we asked people's perception of land in agricultural uses and urban growth around their residence. 79% of respondents agreed, or strongly agreed, that the primary function of land in agricultural uses is to produce food. 65% of respondents agreed, or strongly agreed, that land in agricultural uses helps to clear air and water and conserve the diversity of natural systems. 61% of respondents agreed, or strongly agreed, that is it desirable to live near land in agricultural uses, while the majority of respondents (93%) agreed or strongly

agreed that it is important to preserve land in agricultural uses for future generations. When it comes to the benefits of agricultural land, around 47% of respondents disagree or are uncertain that land in agricultural uses provides social benefits such as recreational opportunities. 66% of respondents agreed, or strongly agreed, that the economic benefits from land in agricultural uses outweigh the benefits that urban land uses provide. Overall, the large majority of respondents appreciated the food production value of farmland, smaller majorities appreciate the amenity values that farmland provides (Table 4.2).

Table 4.2 Respondents' Attitude towards Land in Agricultural Land (N=1303)

Statement	Percentage				
	Strongly disagree （%）	Somewhat disagree （%）	Neither agree nor disagree （%）	Agree （%）	Strongly agree (%)
The primary function of land in agricultural uses is to produce food	3.30	7.90	9.44	53.42	25.94
Land in agricultural uses helps to clean air and water	2.53	11.82	22.18	45.28	18.19
Land in agricultural uses conserves the diversity of natural systems	4.07	12.36	20.87	45.59	17.11
Land in agricultural uses provides social benefits such as recreational opportunities	3.45	14.50	28.70	41.67	11.67
It is important to maintain land in agricultural uses for future generations	1.77	1.15	4.14	37.45	55.49
The economic benefits from land in agricultural uses outweigh the benefits that urban land uses provide	1.38	6.06	26.17	40.60	25.79
It is desirable to live near land in agricultural uses	1.15	7.60	29.55	41.60	20.11

Source: authors

The next warm-up question focused on respondents' attitudes toward development planning and conservation of agricultural lands and natural area systems. Around 41% of respondents think that insufficient land is reserved for agricultural uses, while the same percentage think that enough land is reserved for agriculture. 57% of respondents think there is not enough land reserved as natural areas, while around 78% of respondents think that enough or too much land is set aside for urban growth. Overall, more respondents are disposed to conserving additional amounts of natural lands than agricultural lands (Figure 4.1).

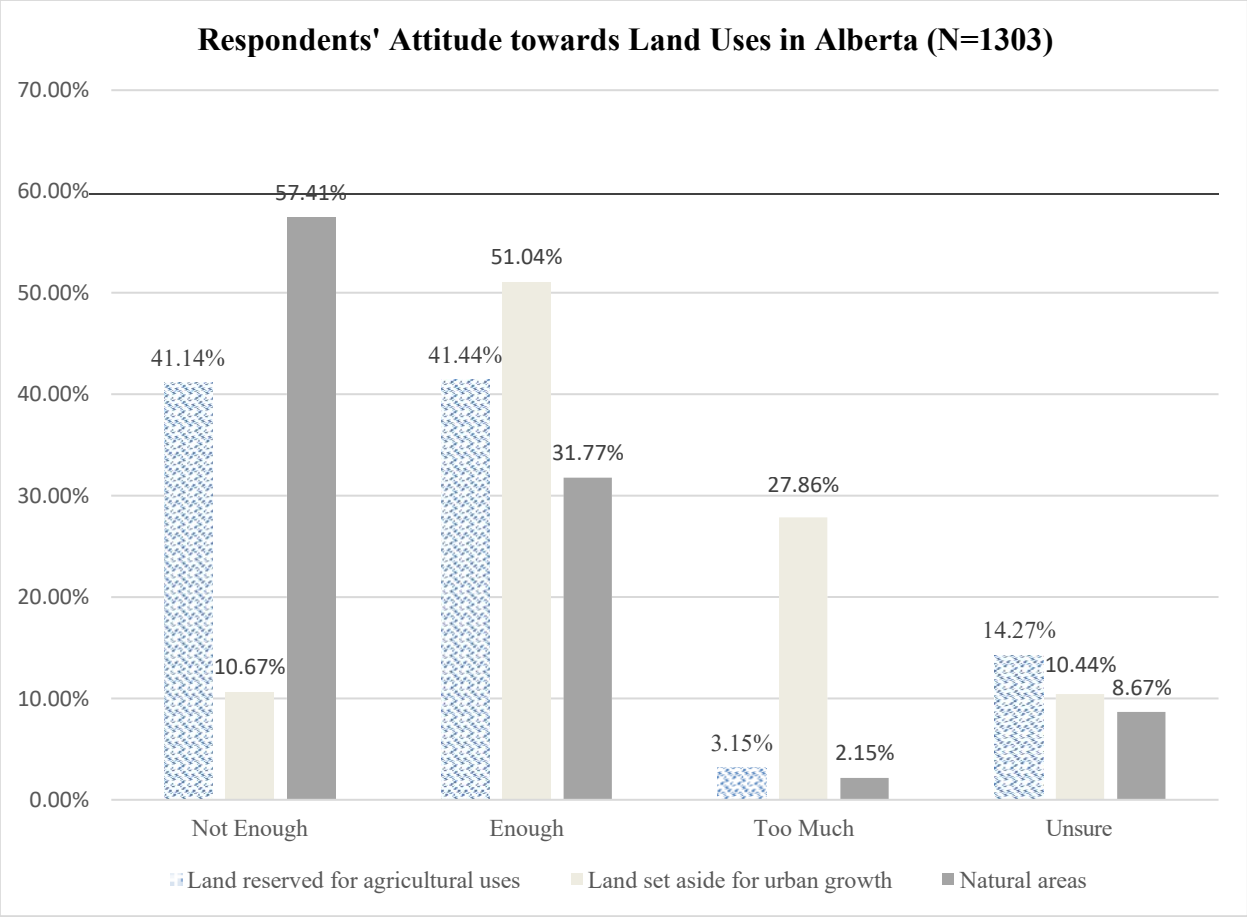


Figure 4.1 Respondents' Attitude towards Land Use in Alberta (Source: authors)

The last attitudinal question concerns respondents' perceptions of future types of urban development. Relative to the 2000-2016 development trend in their area, 9% favored more expansionary forms of urban development, 30% preferred to continue the 2000-2016 trend, while 61% preferred denser forms of urban development that would reduce pressure to convert surrounding farmland (Figure 4.2). Thus, we conclude that a majority of these respondents were at least somewhat concerned about the loss of agricultural land associated with expansionary development trends.

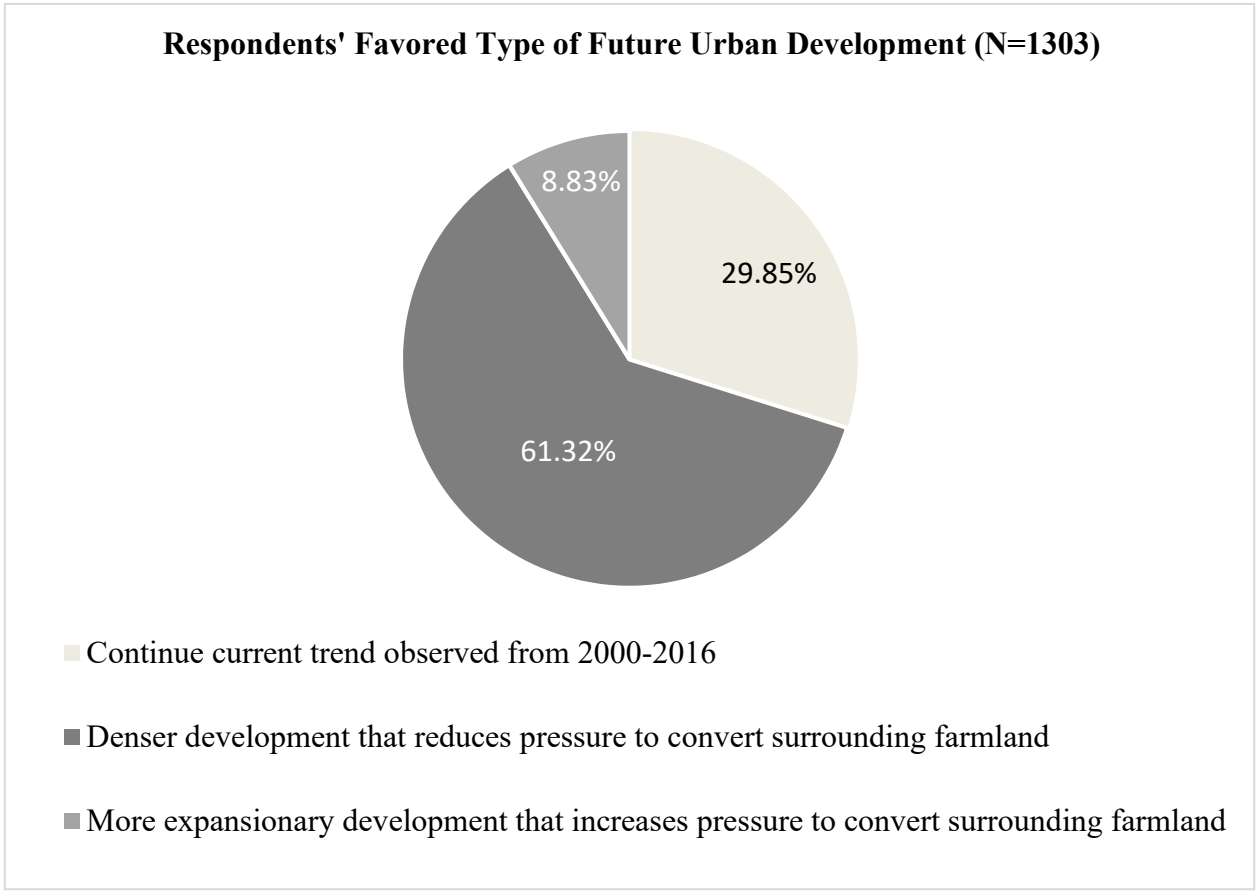


Figure 4.2 Respondents' Favored Type of Future Urban Development (Source: authors)

4.4. Non-Parametric Analysis

This section reports the percentage of respondents who favor the conservation strategies described in the WTP survey and the development strategies described in the WTA survey.

Figure 4.3 shows that around 58% of the WTP respondents were willing to pay the amounts stipulated in the choice experiment scenarios (minimum of $50, maximum of $1000) toward the conservation of an additional 1000 acres parcel of farmland somewhere within 10 km of current urban areas. 72% of WTP respondents were willing to make a one-time contribution at the lowest cost level ($50) toward that conservation, while 40% were willing to make a one-time contribution at the highest cost level ($1000). As expected, fewer respondents are willing to pay for higher cost land conservation.

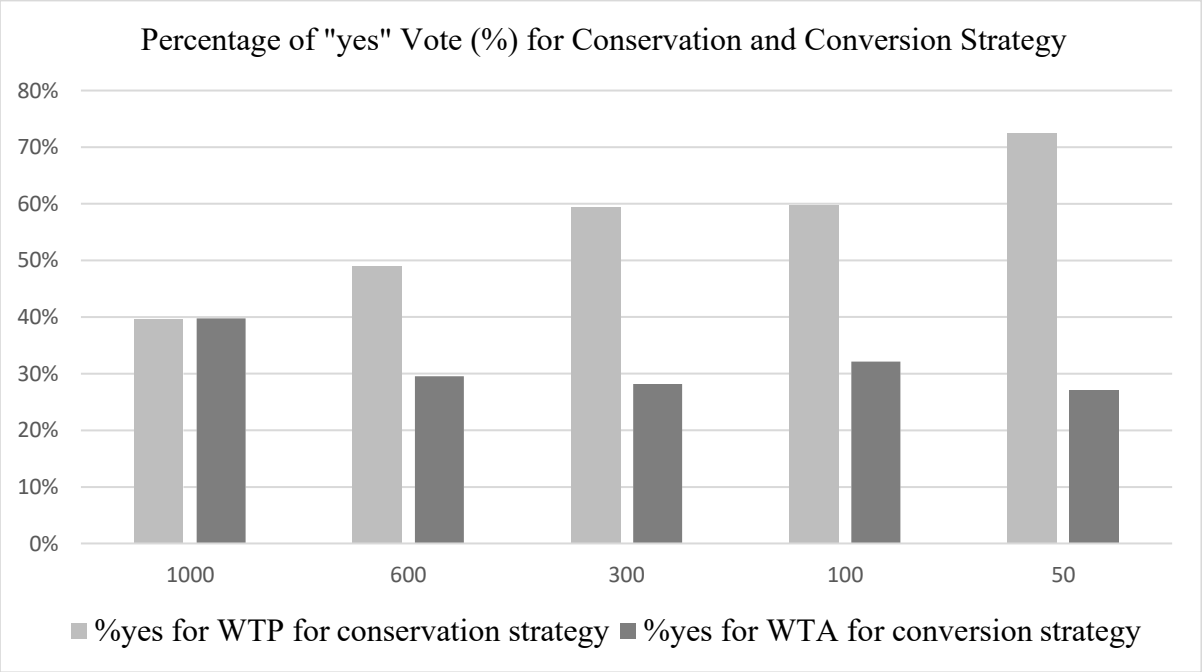


Figure 4.3 Percentage of “yes” Vote for Conservation and Conversion Strategy at Each Cost Level (Source: authors)

Only 31% of respondents were willing to receive the levels of compensation stipulated in the choice experiments to allow an additional 1000 acres parcel of farmland to be developed within 10 km of current urban areas. 40% of respondents indicated that they would be willing to allow that development in return for a one-time tax reduction of $1000, while 27% would be willing to allow that development in return for a one-time tax reduction of $50. Although the gap between lowest to highest cost level is lower than for the conservation scenario, these results still show that more people are willing to accept compensation at higher levels of compensation payment.

Respondents who do not approve the mechanism described in the survey or do not give valid responses can be defined as protest respondents (Halstead et al., 1992). Meyerhoff and Liebe (2008) indicate that stated preference methods may not estimate accurate economic values if protest responses appear in the process of valuation. Based on previous studies and best practice (Meyerhoff and Liebe, 2010), the following steps were applied to deal with protest and uncertain votes. First, project-rejectors were removed from the dataset. The project PI identified likely protest votes on the basis of comments that respondents provided to an optional open-ended question at the end of the survey. 28 WTP respondents (4.36%) and 13 WTA respondents were identified as project-rejectors (1.97%). We thus conclude that most respondents accepted the plausibility of the scenarios. Second, respondents to the WTA survey indicated uncertainty about their responses for 15.34% of the WTA scenarios and thus were recoded from not accept to accept (1,588/10,352 scenario responses). Respondents to the WTP survey indicated uncertainty about their responses for 8.56% of the WTP scenarios and thus were recoded from willing to not willing to pay (842/9,840 scenario responses). The effects of this re-coding are discussed in section 4.6 on robustness checks.

4.5. Basic analysis of WTP and WTA

Random Utility Model is the over-arching theory that we draw upon to translate the choice experiment data into estimates of marginal utility of the strategies and the attributes of those strategies. MNL is used as the base model, recognizing that some of the assumptions of MNL may not hold, eg IID and limited substitution between properties (section 2.3.2). Heterogeneity can be addressed through the inclusion of interaction terms in the MNL or by using latent class or random parameter logit models.

4.5.1. Results for Willingness to Pay

Maximum likelihood estimation of a multinomial logit model was adopted as the basic analysis. As can be seen from the Table 4.3, the coefficient on price is negative and significant, which means that people have a positive marginal utility of money, and their utility will decrease if the one-time additional increase in property tax for the strategy increased. ASC is an alternative specific constant which was defined as the utility of choosing a baseline strategy (to avoid grain or oilseed farming converting to residential use). The coefficient of ASC is positive and significant, indicating that the utility of choosing the baseline strategy increases indirect utility compared with choosing the status quo (no additional conservation strategy). The dummy variables for the vegetable and livestock grazing as current agricultural land uses, and retail and light industrial as alternative developed land uses are all insignificant, which indicates respondents have no common preferences regarding the type of current agricultural land use or the type of alternative developed land use.

In this next step, we report results for MNL models with interaction terms. The model with exogenous variables includes interactions between ASC and demographic and socio-economic

characteristics that can be considered exogenous to the choice context, including *gender* (a dummy variable equals to one if the respondent is male), *age* (continuous variable), *city* (a dummy variable equals to one if the respondent lives in city), *education* (a dummy variable equals one if the highest level of education the respondent received is completed university undergraduate degree or completed post-graduate degree), *employment* (a dummy variable equals to one if the respondent has a full-time job), *ownresidence* (a dummy variable equals to one if the respondent own residence), *rentresidence* (a dummy variable equals to one if the respondent rent residence), and *ownagriland* (a dummy variable equals to one if the respondent own agricultural land). The model with endogenous variables includes interactions between ASC and attitudinal characteristics that can be co-determined with WTP, including the dummy variables, *noenoughagriland* and *denserdevelopment*. The *noenoughagriland* and *denserdevelopment* come from the answers of questionnaires and indicate respondents' attitudes toward current agricultural land use and future urban development. The third model combines both endogenous and exogenous interaction terms for comparison.

Table 4.3 MNL Coefficient Estimates with Exogenous and Endogenous Variables Interactions (WTP)

Attributes	Basic Model	Model with Exogenous Variables	Model with Endogenous Variables	Model with all variables
	Coefficient (Std.Err)	Coefficient (Std.Err)	Coefficient (Std.Err)	Coefficient (Std.Err)
price	-0.00133***	-0.00134***	-0.00139***	-0.00139***
	(8.81e-05)	(8.83e-05)	(9.01e-05)	(9.03e-05)
ASC	0.564***	-0.125	0.0825	-0.632**
	(0.0678)	(0.242)	(0.0801)	(0.250)
vegetable	0.0418	0.0419	0.0434	0.0433
	(0.0728)	(0.0730)	(0.0743)	(0.0744)
livestock	-0.0816	-0.0835	-0.0896	-0.0919

	(0.0742)	(0.0744)	(0.0756)	(0.0758)
retail	-0.0151	-0.0146	-0.0137	-0.0129
	(0.0730)	(0.0732)	(0.0745)	(0.0746)
light industrial	-0.0266	-0.0235	-0.0181	-0.0135
	(0.0739)	(0.0742)	(0.0753)	(0.0756)
ASC*gender	-	-0.136**	-	-0.0896
		(0.0619)		(0.0631)
ASC*age	-	0.00803***	-	0.00549**
		(0.00210)		(0.00216)
ASC*city	-	-0.00463	-	0.00736
		(0.0681)		(0.0695)
ASC*education	-	0.00484	-	-0.0325
		(0.0612)		(0.0624)
ASC*employment	-	0.0816	-	0.0975
		(0.0621)		(0.0633)
ASC*ownresidence	-	0.276	-	0.415**
		(0.203)		(0.206)
ASC*rentresidence	-	0.480**	-	0.597***
		(0.204)		(0.207)
ASC*ownagriland	-	0.0561	-	-0.0540
		(0.131)		(0.134)
ASC*noenoughagriland	-	-	0.683***	0.685***
			(0.0617)	(0.0622)
ASC*denserdevelop	-	-	0.345***	0.336***
			(0.0626)	(0.0632)
AIC	6582.109	6573.755	6402.22	6400.045
BIC	6625.274	6674.474	6459.774	6515.153
Log-likelihood	-3285.0545	-3272.8773	-3193.11	-3184.0226
Observations	9840	9840	9840	9840

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Note: Using the data when uncertain votes are recoded as preferring status quo, and project-rejectors are removed. (Source: authors)

In the model with endogenous variables, *Gender* is negative and significant, indicating that males are less likely to vote for the conservation strategy. *Age* and *Rentresidence* are both positive and significant, indicating that older persons and persons who rent their residence are more likely to

prefer the conservation strategy. Otherwise, *city, education, employment, ownresidence,* and *ownagriland* are all insignificant, which indicates that none of these characteristics have consistent effects on respondents' farmland conservation preferences. The model with endogenous variables shows that some endogenous variables – attitudinal variables that may be co-determined with WTP -- are positive and significant. People who think there now is insufficient land reserved for agriculture, and people who favor denser development are more likely to vote for the conservation strategy. These findings show that respondents' characteristics and attitudes could affect their voting. This implies that the assumption of homogenous preferences across respondents is not valid, and thus it is not appropriate to use the MNL model. As discussed in section 2.4 above, Latent Class Models and Random Parameter Logit Models are alternative approaches to coping with heterogeneous preferences in choice experiment data., Therefore, we estimated a latent class model to identify factors that segment our respondents into different classes and a random parameter logit model to help us better understand the heterogeneity of individual preferences.

We use the results from the MNL model with endogenous and exogenous variables to identify demographic and attitudinal variables to include in the Latent Class Model. Specifically, we include all variables that had significant effects on utility in the MNL models. When estimating an LCM, the analyst must choose the number of classes. Models with two to six classes were attempted and Table 4.4 summarizes the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) statistics. The log likelihood values at convergence indicate the improvement in the model fit when classes are added to the model. In both models, AIC values decrease as the number of classes increase but the amount of the decrease is obviously smaller after class 3. BIC values decline from class 2 and the changes become small from class 3, BIC

values rise when additional classes beyond class 5 are added. Except for the information criteria, Scarpa and Thiene (2005) suggested that the statistical significance of the parameter estimates will decrease when the number of classes increases. Based primarily on the AIC and BIC criteria, and the significance of the parameter estimates, we decided to proceed with a 3-class model.

Table 4.4 Information criteria for different classes in exogeneous and endogenous latent class models

Class Definition	Log Likelihood	Nparam	AIC	BIC
Exogenous				
1	-3274.942	9	6567.884	6632.632
2	-2631.762	16	5295.525	5366.271
3	-2499.087	26	5050.175	5165.137
4	-2440.983	36	4953.966	5113.145
5	-2404.23	46	4900.46	5103.855
6	-2392.206	56	4896.412	5144.023
Endogenous				
1	-3193.11	8	6402.22	6459.774
2	-2614.7	15	5259.39	5325.72
3	-2476.5	24	5000.9	5107.02
4	-2421.6	33	4909.2	5055.11
5	-2382.8	42	4849.54	5035.25
6	-2373.1	51	4848.25	5073.75

Source: authors

All respondents are assigned to one of the three latent classes. Compared to the basic MNL model, lower AIC and BIC values and larger log likelihood value from the latent class model show that the explanatory power improves when unobserved sources of heterogeneity were accounted for. The dis-similar results across the classes indicates that respondents have highly heterogeneous preferences regarding attributes in the model.

The Latent Class Model is composed of two parts: the choice and the class membership model components, hence, two sets of estimates related to these components were obtained as shown in Table 4.5. The results from Class 1 and Class 2 are estimates of the probability that a respondent with a certain characteristic is likely to be sorted into each of the three classes, with the third class being the default or reference choice. Columns 2-4 show the results when exogenous factors are related to class membership, columns 5-7 show the results when endogenous factors are related to class membership. If the estimate of a membership factor is positive and significant, it means that a respondent with this characteristic has a significantly higher probability of belonging to this class. The only variable that is significant in model 1 is *Rentresidence*. Renters are most likely to be in class 1, than class 2. Model 2 results indicate that attitudes also sort respondents into classes. People who think that enough agricultural land is conserved are highly likely to be in class 1, and highly unlikely to be in class 2. Respondents in favor of denser development have low probability of being in class 1 or class 2.

The primary insights into heterogeneity from the two latent class models reported on Table 4.5 are:

- The class shares are roughly equal, with 30-35% of respondents falling into each of the three classes.
- In Model 1, respondents in classes 1 and 3 are sensitive to the amount that they would be expected to pay, while respondents in class 2 generally vote against additional conservation and are insensitive to the required payment amount. Thus, we conclude that about one third of respondents oppose making any financial contribution to farmland conservation, regardless of the cost.

- In Model 2, respondents in class 2 (mostly people who think there is enough agricultural land conserved) generally do not vote for the additional conservation and do not care about the effect of changes of prices. Respondents in classes 1 and 3 favor additional the conservation strategy, each of whom comprise one third of respondents.
- In both models, respondents in classes 2 and 3 have no consistent preference on the type of agricultural land or the type of alternative development use.
- Respondents who are likely to rent their residence or think there is not enough agricultural land, tend to strongly prefer the conservation of vegetable land. They prefer to avoid conversion of farmland into retail or industrial uses.

We note that three location variables were also included in other versions of the LC model, which are not reported here. This includes whether or not the respondent lives in a city and which of the 6 study areas that respondent resided in. None of these factors were statistically significant. Additional research on the effect of location on willingness to pay or willingness to accept is beyond the scope of this thesis but is recommended for further study. This survey collected data on the postal code of each respondent that could be combined with data extracted from GIS.

Table 4.5 Latent Class Model (LC) Coefficient Estimates (WTP) (with exogenous and exogenous variables)

	Model 1: adding exogenous variables			Model 2: adding exogenous variables		
Variables	Class 1 Coefficient (Std. Err)	Class 2 Coefficient (Std. Err)	Class 3 Coefficient (Std. Err)	Class 1 Coefficient (Std. Err)	Class 2 Coefficient (Std. Err)	Class 3 Coefficient (Std. Err)
Choice model parameters						
Price	-0.00109***	5.71E-05	-0.00449***	-0.000997***	5.90E-05	-0.00424***
	(0.000264)	(0.000369)	(0.000655)	(0.000273)	(0.000351)	(0.00054)
ASC	2.106***	-2.426***	1.807***	2.091***	-2.508***	1.779***
	(0.212)	(0.461)	(0.278)	(0.219)	(0.416)	(0.256)

vegetable	0.747***	0.33	-0.296	0.763***	0.399	-0.292
	(0.26)	(0.248)	(0.193)	(0.26)	(0.245)	(0.187)
livestock	-0.194	0.218	-0.281	-0.173	0.175	-0.245
	(0.211)	(0.242)	(0.185)	(0.222)	(0.257)	(0.178)
retail	0.403*	0.19	-0.187	0.429*	0.22	-0.211
	(0.207)	(0.28)	(0.177)	(0.219)	(0.271)	(0.168)
light industrial	0.408*	0.0838	0.0221	0.430*	0.107	-0.0503
	(0.243)	(0.294)	(0.204)	(0.257)	(0.289)	(0.185)
			Class membership model parameters			
Gender	0.263	0.403	-	-	-	-
	(0.259)	(0.253)				
Age	0.00757	-0.00553	-	-	-	-
	(0.00782)	(0.00809)				
Rentresidence	0.647**	0.316	-	-	-	-
	(0.263)	(0.277)				
notenough agriland	-	-	-	0.815***	-0.414*	-
				(0.229)	(0.248)	
denser development	-	-	-	-0.498*	-1.052***	-
				(0.257)	(0.247)	
Constant	-0.635	-0.0824	-	-0.125	0.622**	-
	(0.44)	(0.468)		(0.287)	(0.277)	
Class Share	0.346	0.315	0.339	0.334	0.309	0.357
			Model fit			
AIC		5050.168			5000.898	
BIC		5237.218			5173.559	
Log likelihood		-2499.084			-2476.4489	
Observations	9,840	9,840	9,840	9,840	9,840	9,840

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

(Note: This uses data when uncertain votes are recoded as preferring status quo, and project-rejectors are removed.) Source: authors.

Although the Latent Class analysis generates a great deal of information, the lack of significant membership variables weakens the insights that can be generated. The random parameter model provides an alternative approach to understanding heterogeneity of responses.

In the random parameter model (RPL), all non-monetary attributes are specified as random variables that are assumed to be normally distributed. Table 4.6 shows the WTP results obtained using the RPL model. The RPL basic model is estimated for the full sample of WTP responses, while the other models are estimated for sub-sets of WTP responses, with the number of observations reported at the bottom of each model results. The first column of parameters reports the population means ($\bar{\beta}$ in equation (8)), with their standard errors, while the second column reports the standard deviation of preferences across the sample ($\tilde{\beta}_k$ equation (8)) (Holmes et al, 2017).

Consider first the results for the RPL, basic model, reported in the second and third columns of Table 4.6. Four of the standard deviation coefficients are statistically significant, indicating that the RPL model captures unobserved heterogeneity. Also, the standard deviation estimates are large relative to the mean values, indicating large variation in preferences. For example, the coefficient for the livestock grazing attribute is -0.0735 and statistically insignificant, while the standard deviation is 1.737 and highly statistically significant. It means that respondents as a group do not have consistent preferences between grain / oilseed and livestock grazing as current land uses, but there is significant heterogeneity among individual respondents.

Next, we consider results of the RPL estimated for different sub-populations, as shown in the Table 4.6, 4.7, 4.8 and 4.9. Firstly, in the survey, around 56% of respondents believed that the additional conservation strategies are likely to be implemented. We call these respondents our 'strategy believers' group. We wanted to determine if there is any difference in preferences between the 'all respondents' group and 'strategy believers' group, therefore we estimated the model just using data from respondents who believed that the conservation strategies could be implemented in their

area. The results indicate that the ASC in the 'strategy believers' group is higher than the value in the basic model, indicating that respondents in this group vote for the baseline strategy more than respondents in the full sample.

Some of the comments received from the open-ended comment section in the survey suggests that people who are retired may be less willing or able to pay for conservation. We thus estimated the model just using data for retired respondents. Table 4.6 shows that retired respondents are more likely to want to conserve commercial vegetable land compared with grain or oilseed land, and, counter to our hypothesis, they are willing to pay more to support agricultural land conservation.

One of the focus groups raised the possibility that people living on limited incomes may not be willing or able to pay for farmland conservation. The median income level is $60,000 - $89,999 in this survey. We thus estimated the model for the 'greater than median income' group and 'smaller than or equal to median income' group. We found no large difference when it comes to the signs and significance of coefficients, however, the ASC of the high-income group is larger than the low-income group, indicating that the high-income group is more likely to support the baseline conservation strategy.

We also compared results generated for Calgary, Edmonton and the other smaller cities as a group. Similar to the basic result, all coefficients of attributes for type of lands are insignificant. The result from Edmonton region and Calgary regions are very similar to the results of the basic model, suggesting similarities across Alberta's two major cities. Respondents from other places have no preference on whether there is an additional conservation strategy. A potential reason for this result is that the small sample size for this group does not capture sufficient variation. Preferences from respondents who own their residence and rent their residence were also compared. Respondents

who own their residence are more willing to vote in favour of the conservation strategy than respondent who rent their residence. Both groups have no consistent preferences on other attributes. In terms of Male and Female groups, we found their willingness to pay to be quite close, with somewhat less support for conservation among males (Table 4.9).

Tables 4.10 and 4.11 present estimates of the marginal willingness to pay for farmland conservation generated for different groups of respondents. The second and third columns are the basic model results, estimated using MNL and RPL. Here we focus on the RPL results. Across the whole sample, the average respondent is willing to make a one-time payment of between $340.15 and $475.90 to conserve 1000 acres of farmland that would otherwise be converted into non-agricultural uses. Marginal willingness to pay is lowest for the conversion of livestock grazing on native pasture being converted to light industrial, and highest for the conversion of commercial vegetable farms into residential or retail. For each current agricultural use, there is relatively little variation in MWTP depending on the future land use, be it residential, retail or light industry. For example, MWTP for conservation of commercial vegetable production land varies only between $448.55 and $475.90. That order of preference – highest willingness to pay to conserve commercial vegetable land, lowest willingness to pay to conserve livestock grazing on native pasture, moderate willingness to pay to conserve cropland – tends to be preserved when the model is estimated for the different sub-populations – high or low income, retired, and those who strongly believe that this conservation strategy could be implemented, male or female, or resident in Calgary, Edmonton or the other smaller cities. Across the demographic groups, the highest willingness to pay is reported for retired people and the lowest for low income people. Female respondents had higher MWTP than male respondents, an average of 26% higher across the nine

conservation scenarios. Respondents who rent residence are willing to pay more than respondents who own rent residence for every strategy. Across the three regional groups, respondents from the Edmonton region had the highest MWTP, followed by Calgary, and other locations as a group. Respondents from the Edmonton region are willing to pay the most to conserve commercial vegetable land, then livestock grazing on natural pasture, then cropland, but do not express particular preferences for the conversion of that land to retail, residential or light industrial uses. These results are consistent with Wang and Swallow (2016). The same general pattern is also seen for the other places, although at considerably lower levels of MWTP. Land use conversion concerns appear to be considerably different in Calgary. With MWTP about very close to equal for crop or vegetable land, and considerably lower for livestock grazing on natural pasture.

The Census of Canada indicated that there were about 1,527,675 households in Alberta, 502,140 households in Edmonton region, and 558,915 household in Calgary region in 2016 (Government of Canada, 2017). Combining these numbers with the MWTP estimates, we can estimate the aggregate WTP per acre for the Edmonton and Calgary regions as (MWTP / 1000) * HHnumber. The MWTP for the full sample ranges from CAD$340.15 to CAD$475.90 per household per 1000 acres, therefore, we calculate that the aggregate WTP per acre ranges from CAD$519,639 to CAD$727,021. The MWTP for respondents living in the Edmonton and Calgary regions ranges from CAD$396.51 to CAD$546.75 and from CAD$317.60 to CAD$440.98 per household, per 1000 acres, respectively. The aggregate WTP for an additional conservation strategy per acre ranges from CAD$199,103 to CAD$274,545 in Edmonton and CAD$177,511 to CAD$246,470. This range is somewhat larger than the range (CAD$20,000 to CAD$129,000) in the Alberta Capital Region estimated by Wang & Swallow (2016). Table 4.12 summarizes the ranges of

aggregate willingness to pay for farmland conservation and acres conserved in the 6 areas covered by this study. The lowest/ highest aggregate WTP can be gained by multiplying lowest/highest MWTP by the number of households of the area. Bentley (2016) found that prices of farms located near to Highway2 are higher than prices of farms located further from Edmonton, Calgary and Edmonton-Calgary corridor. Thus, we assume the highest farmland value reported by Farm Credit Canada (2019) as the farmland cost per acre. Due to irrigation of farmland, farmland values in Lethbridge and Medicine Hat are highest. Acres conserved is calculated as aggregate willingness to pay divided by highest farmland values for area. Potential acres conserved are highest in the Edmonton and Calgary regions, at 42,238 and 28,996 acres respectively.

Edmonton residents appear to favor conservation of livestock grazing on native pasture over cropland, while livestock grazing on native pasture is of least concern in Calgary and the other smaller cities. This result is consistent with Wang and Swallow (2016) and it is interesting to see the differences across the study sites. Contrary to expectations, respondents did not express consistent difference in MWTP depending on the type of replacement land use. The high heterogeneity of preferences bears further examination.

Table 4.6 Random Parameter Logit Model (RPL) Coefficient Estimates (WTP) (basic model, strategy believers, retired)

Attributes	RPL (basic model)		Strategy believers		Retired	
	Coefficient	Coefficient (Std. Dev.)	Coefficient	Coefficient (Std. Dev.)	Coefficient	Coefficient (Std. Dev.)
price	-0.00188***		-0.00188***		-0.00243***	
	(0.000121)		(0.000156)		(0.000352)	
ASC	0.763***		1.110***		1.335***	
	(0.0776)		(0.108)		(0.232)	
vegetable	0.13	1.888***	0.195	1.837***	0.666*	2.304***
	(0.124)	(0.201)	(0.166)	(0.271)	(0.399)	(0.588)
livestock	-0.0735	1.737***	-0.225	1.348***	0.112	1.950***
	(0.125)	(0.206)	(0.156)	(0.256)	(0.388)	(0.608)
retail	-0.00467	1.858***	0.147	1.626***	0.153	1.986***
	(0.124)	(0.187)	(0.153)	(0.228)	(0.355)	(0.550)
light industrial	-0.0513	2.067***	0.255	2.202***	0.0110	2.112***
	(0.141)	(0.199)	(0.196)	(0.298)	(0.396)	(0.563)
AIC	6014.723		3368.716		812.6953	
BIC	6086.665		3434.877		864.9646	
Log likelihood	-2997.3614		-1674.3581		-396.34763	
Observations	9,840		5,520		1376	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Using the data when uncertain votes are recoded as preferring status quo, and project-rejectors are removed. Source: authors.

Table 4.7 Random Parameter Logit Model (RPL) Coefficient Estimates (WTP) (high income, low income, own residence, rent residence)

Attributes	High income		Low income		Own residence		Rent residence	
	Coefficient	Coefficient (Std. Dev.)	Coefficient	Coefficient (Std. Dev.)	Coefficient	Coefficient (Std. Dev.)	Coefficient	Coefficient (Std. Dev.)
price	-0.00211***		-0.00211***		-0.00209***		-0.00142***	
	(0.000193)		(0.000193)		(0.000150)		(0.000209)	
ASC	0.971***		0.971***		0.828***		0.616***	
	(0.127)		(0.127)		(0.0944)		(0.137)	
vegetable	0.136	1.453***	0.136	1.453***	0.0797	1.784***	0.355	2.412***
	(0.179)	(0.319)	(0.179)	(0.319)	(0.147)	(0.240)	(0.257)	(0.439)
livestock	-0.135	1.193***	-0.135	1.193***	-0.0380	1.714***	-0.0604	1.949***
	(0.182)	(0.326)	(0.182)	(0.326)	(0.152)	(0.249)	(0.233)	(0.339)
retail	0.0468	2.192***	0.0468	2.192***	-0.0397	1.864***	0.0459	1.696***
	(0.208)	(0.312)	(0.208)	(0.312)	(0.152)	(0.221)	(0.212)	(0.315)
light industrial	-0.19	2.431***	-0.19	2.431***	-0.0778	2.151***	0.135	1.986***
	(0.244)	(0.365)	(0.244)	(0.365)	(0.172)	(0.244)	(0.250)	(0.378)
AIC	3664.132		2344.769		4116.576		1902.152	
BIC	3731.074		2407.343		4184.8		1962.4	
Log likelihood	-1822.0662		-1162.3847		-2048.288		-941.0759	
Observations	5,968		3856		6784		3056	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Using the data when uncertain votes are recoded as preferring status quo, and project-rejectors are removed. Source: authors.

Table 4.8 Random Parameter Logit Model (RPL) Coefficient Estimates (Edmonton, Calgary, Other places)

Attributes	RPL (Edmonton region)		RPL (Calgary region)		RPL (Other places)	
	Coefficient	Coefficient (Std. Dev.)	Coefficient	Coefficient (Std. Dev.)	Coefficient	Coefficient (Std. Dev.)
price	-0.00182***		-0.00183***		-0.00294***	
	(0.000183)		(0.000182)		(0.000739)	
ASC	0.776***		0.788***		0.548	
	(0.12)		(0.119)		(0.343)	
vegetable	0.206	1.877***	0.0159	1.563***	-0.204	3.618***
	(0.193)	(0.317)	(0.174)	(0.284)	(0.892)	(1.243)
livestock	0.111	1.901***	-0.193	1.354***	-0.11	-0.512
	(0.204)	(0.319)	(0.176)	(0.282)	(0.474)	(0.976)
retail	0.0158	1.924***	0.0029	1.863***	0.298	2.038**
	(0.193)	(0.3)	(0.19)	(0.272)	(0.616)	(0.895)
light industrial	-0.0525	2.095***	-0.0134	1.962***	-0.469	3.284***
	(0.222)	(0.334)	(0.203)	(0.293)	(0.776)	(1.171)
AIC	2539.136		2554.527		313.2515	
BIC	2602.43		2617.705		355.9425	
Log likelihood	-1259.568		-1267.2634		-146.62574	
Observations	4144		4096		528	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Using the data when uncertain votes are recoded as preferring status quo, and project-rejectors are removed. Source: authors.

Table 4.9 Random Parameter Logit Model (RPL) Coefficient Estimates (male, female)

Attributes	RPL (male)		RPL (female)	
	Coefficient	Coefficient (Std. Dev.)	Coefficient	Coefficient (Std. Dev.)
price	-0.00164***		-0.00203***	
	(0.000191)		(0.000157)	
ASC	0.600***		0.867***	
	(0.123)		(0.100)	
vegetable	0.175	1.864***	0.109	1.925***
	(0.199)	(0.340)	(0.161)	(0.251)
livestock	0.0176	1.502***	-0.104	1.925***
	(0.191)	(0.307)	(0.168)	(0.252)
retail	-0.141	2.053***	0.0829	1.749***
	(0.211)	(0.317)	(0.155)	(0.224)
light industrial	-0.201	2.383***	0.0379	1.957***
	(0.236)	(0.374)	(0.176)	(0.244)
AIC	2347.969		3675.644	
BIC	2410.418		3742.693	
Log likelihood	-1163.9847		-1827.8222	
Observations	3,808		6032	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Using the data when uncertain votes are recoded as preferring status quo, and project-rejectors are removed. (Source: authors)

Table 4.10 Estimated MWTP for the Farmland Conservation Strategy in Alberta (per acre, per household, next year only) (MNL, RPL: basic model, high income, low income, retired, strategy believers)

Conservation Strategy	MNL	RPL	RPL			
	Basic Model	Basic Model	High income	Low income	Retired	Strategy believers
Grain or oilseed farming; Residential	423.07***	406.67***	460.93***	364.50***	549.69***	592.01***
Commercial vegetable farm; Residential	454.48***	475.90***	525.34***	442.34***	824.08***	695.91***
Livestock grazing on native pasture; Residential	361.79***	367.50***	396.98***	355.49***	595.99***	472.16***
Grain or oilseed Farming; Retail	411.71***	404.19***	483.15***	354.51***	612.66***	670.18***
Commercial vegetable farm; Retail	443.11***	473.41***	547.56***	432.36***	887.05***	774.08***
Livestock grazing on native pasture; /Retail	350.43***	365.01***	419.21***	345.51***	658.96***	550.33***
Grain or oilseed farming; Light industrial	403.11***	379.33***	370.72***	391.87***	554.22***	728.12***
Commercial vegetable farm; Light industrial	434.52	448.55***	435.12***	469.71***	828.61***	832.02***
Livestock grazing on native pasture; Light industrial	341.83***	340.15***	306.77***	382.86***	600.52***	608.27***

*** p<0.01, ** p<0.05, * p<0.1

(Note: Using the data when uncertain votes are recoded as preferring status quo, and project-rejectors are removed.) Source: authors.

Table 4.11 Estimated MWTP for the Farmland Conservation Strategy in Alberta (per acre, per household, next year only) (WTP)

Conservation Strategy	RPL Male	RPL Female	RPL Edmonton region	RPL Calgary region	RPL Other places	RPL Own residence	RPL Rent residence
Grain or oilseed farming; Residential	366.68***	426.38***	425.29***	430.72***	290.77***	395.57***	433.54***
Commercial vegetable farm; Residential	473.37***	480.16***	538.09***	439.40***	395.41*	433.64***	683.56***
Livestock grazing on native pasture; Residential	377.41***	375.43***	486.41***	324.92***	196.09	377.40***	391.02**
Grain or oilseed Farming; Retail	280.38**	467.12***	433.95***	432.31***	308.08**	376.62***	456.81***
Commercial vegetable farm; Retail	387.06**	520.90***	546.75***	440.98***	412.72*	414.69***	715.83***
Livestock grazing on native pasture; /Retail	291.11**	416.17***	495.06***	326.51***	213.40	358.45***	423.29**
Grain or oilseed farming; Light industrial	243.68*	445.04***	396.51***	423.40***	310.42*	358.41***	528.24***
Commercial vegetable farm; Light industrial	303.66**	498.82***	509.31***	432.07***	415.06*	396.48***	778.26***
Livestock grazing on native pasture;	254.41*	394.09***	457.62***	317.60***	215.74	340.24***	485.71**

*** p<0.01, ** p<0.05, * p<0.1

Using the data when uncertain votes are recoded as preferring status quo, and project-rejectors are removed. Source: authors.

Table 4.12 Ranges of Aggregate WTP and Ranges of Acres Conserved

	Lowest WTP (CAD$ per acre))	Highest WTP (CAD$ per acre)	Highest Farmland Values (CAD$ per acre)	Lowest area potentially conserved (acres)	Highest area potentially conserved (acres)
Grande Prairie	6,818,557	9,733,157	3,200	2,131	3,042
Edmonton	199,103,000	274,545,000	6,500	30,631	42,238
Red Deer	11,545,023	16,479,957	8,500	1,358	1,939
Calgary	177,511,000	246,470,000	8,500	20,884	28,996
Lethbridge	13,286,735	18,966,167	14,100	942	1,345
Medicine Hat	7,693,774	10,982,488	14,100	546	779

Data source: (Farm Credit Canada, 2019)

4.5.2. Results for Willingness to Accept

This section follows a similar format to the previous willingness to pay section, starting with the basic multinomial logit model. The coefficient on price is positive and significant, which indicates that higher one-time compensation to each taxpayer will increase respondents' indirect utility. This is expected. ASC represents the utility of a baseline strategy (converting grain land to residential uses), and is negative and statistically significant, which means that respondents prefer the current development trend over additional development. In terms of type of current agricultural use, the coefficient on vegetable is insignificant, while the coefficient on livestock is negative and significant. Therefore, the average respondent has no preference between conversion of vegetable or cropland, but he / she are less likely to accept compensation for land used for livestock grazing, which indicates that he/she has lower preference for conversion of natural pasture used for

livestock grazing and thus they require more money to compensate. This result is consistent with the finding of Wang and Swallow (2016) for the Edmonton area. As for the developed land use, the coefficient on retail is insignificant and the coefficient on light industrial is positive and highly significant, indicating that respondents do not have strong preferences between retail and residential, but prefer conversion to light industrial over retail or residential as the alternative land use. The scenario indicated that the additional land for development would be located within 10 Km of the urban areas. Respondents may consider that to be a reasonable location for light industries over residences or retail establishments.

Following the same steps as for the WTP analysis, significant variables of models with exogenous and endogenous variables can be observed. According to Table 4.13, in the model with exogeneous variables, *gender* is positive and significant, which means that males prefer the conversion strategy over continuation of the current development trend. *age* is also significant, and its negative sign indicates that respondents express strongly preference for the status quo, over additional development, as they became older. *Employment* is also negative and significant, indicating that respondents with a full-time job were less likely to choose the baseline conversion strategy over the status quo. In the model with endogenous variables, respondents who think there is not enough agricultural land prefer the additional development strategy. This is counter to our expectation. Respondents who favor denser development in the future are less likely to choose the development strategy, which is consistent with our expectation.

Table 4.13 MNL Coefficient Estimates with Exogenous and Endogenous Variables (WTA)

Attributes	Basic Models	Model with Exogenous Variables	Model with Endogenous Variables	Both Models
	Coefficient	Coefficient	Coefficient	Coefficient

	(Std.Err)	(Std.Err)	(Std.Err)	(Std.Err)
Price	0.000519***	0.000525***	0.000521***	0.000526***
	(8.29e-05)	(8.33e-05)	(8.30e-05)	(8.35e-05)
ASC	-0.274***	0.238	-0.184**	0.312
	(0.0649)	(0.224)	(0.0758)	(0.227)
vegetable	0.0718	0.0727	0.0720	0.0729
	(0.0694)	(0.0698)	(0.0695)	(0.0699)
livestock	-0.131*	-0.131*	-0.132*	-0.131*
	(0.0712)	(0.0716)	(0.0714)	(0.0718)
retail	-0.0561	-0.0575	-0.0561	-0.0578
	(0.0696)	(0.0700)	(0.0698)	(0.0702)
light Industrial	0.292***	0.292***	0.294***	0.292***
	(0.0710)	(0.0714)	(0.0711)	(0.0716)
ASC*gender	-	0.129**	-	0.122**
		(0.0587)		(0.0590)
ASC*age	-	-0.00921***	-	-0.00849***
		(0.00199)		(0.00202)
ASC*city	-	0.0523	-	0.0406
		(0.0625)		(0.0627)
ASC*education	-	-0.0615	-	-0.0507
		(0.0586)		(0.0588)
ASC*employment	-	-0.121**	-	-0.132**
		(0.0610)		(0.0612)
ASC*ownresidence	-	-0.179	-	-0.214
		(0.183)		(0.183)
ASC*rentresidence	-	0.0944	-	0.0750
		(0.180)		(0.180)
ASC*ownagriland	-	0.0726	-	0.0702
		(0.122)		(0.123)
ASC*noenoughagriland	-	-	0.110*	0.129**
			(0.0575)	(0.0580)
ASC*denserdevelop	-	-	-0.227***	-0.198***

			(0.0575)	(0.0589)
AIC	7113.517	7069.965	7099.433	7058.835
BIC	7156.986	7171.395	7157.393	7174.754
Log-likelihood	-3550.7583	-3520.9827	-3541.7167	-3513.4177
Observations	10352	10352	10352	10352

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Using the data when uncertain votes are recoded as preferring additional development strategies, and project-rejectors are removed. Source: authors.

Next, the significant variables from the MNL were added into the latent class models. The information criteria in the two models (Table 4.14) show that the log-likelihood increases from 2 classes to 6 classes, AIC values decrease from 2 classes to 5 classes and increase from 5 classes to 6 classes, and BIC values decrease from 2 classes to 3 classes and then increase beyond 3 classes. Lower AIC and BIC values and higher log likelihood value in the latent class model indicates that the LCM is more superior to the MNL model. On this basis, we present the results for the 3-class latent class model in Table 4.15.

Table 4.14 Information criteria for different classes in exogeneous and endogenous models

Classes	LLF	Nparam	AIC	BIC
Exogeneity				
1	-3531.059	9	7080.119	7145.323
2	-2950.922	16	5933.844	6005.402
3	-2754.515	26	5561.03	5677.311
4	-2727.146	36	5526.293	5687.297
5	-2712.061	46	5516.122	5721.85
6	-2706.467	56	5524.934	5775.386
Endogeneity				
1	-3541.717	8	7099.433	7157.393
2	-2956.085	16	5942.171	6009.256
3	-2770.47	26	5588.94	5696.277
4	-2748.494	36	5562.989	5710.576
5	-2735.805	46	5555.61	5743.449
6	-2731.423	56	5564.847	5792.936

In Model 1 the results shown in Table 4.15 indicate that gender and employment are not significant determinants of class membership. In Model 1, Age is highly significant, with older people being more likely to be in class 1 and less likely to be in class 2, compared to the likelihood of being in class 3. In Model 2, the estimate of *notenoughagriland* in class 1 is insignificant and negative but it is significant and positive in class 2, which indicates that it is less likely that respondents who think there is insufficient agricultural land will be in class 1 or class 2, and much more likely to be in class 3. Respondents who favor denser development are likely to be in class 1.

Comparing the reference choice (class 3), the primary insights into heterogeneity in two latent class models are:

- In both Model 1 and model 2, respondents in classes 1 and 2 are sensitive to the amount that they would be expected to be compensated and vote against additional conversion, while respondents in class 3 vote for additional conversion and are insensitive to the compensation amount.
- In both models, older respondents and respondents who favor denser development tend to want to protect land for vegetables and grain over livestock grazing and prefer conversion to light industrial over retail or residential.
- The class share results show unequal sized classes. Class 1 contains about 25% of respondents, class 2 contains about 50% of respondents, and class 3 contains about 30% of respondents.

Table 4.15 Latent Class Model (CL) Coefficient Estimates (WTA)

	Model 1: adding exogenous variables			Model 2: adding exogenous variables		
Variables	Class 1 Coefficient (Std. Err)	Class 2 Coefficient (Std. Err)	Class 3 Coefficient (Std. Err)	Class 1 Coefficient (Std. Err)	Class 2 Coefficient (Std. Err)	Class 3 Coefficient (Std. Err)
			Choice model parameters			
price	0.0148***	0.000640***	-0.00553*	0.0162***	0.000718***	-0.00144**
	(0.00222)	(0.000118)	(0.00310)	(0.00291)	(0.000127)	(0.000634)
ASC	-16.24***	-0.186*	12.42**	-17.66***	-0.333***	4.349***
	(2.179)	(0.0980)	(5.546)	(2.869)	(0.112)	(0.956)
vegetable	-0.493	0.0305	-3.843*	-0.593	0.0458	-0.794*
	(0.455)	(0.0968)	(2.283)	(0.494)	(0.101)	(0.427)
livestock	-6.191***	-0.0930	-2.453	-6.571***	-0.0932	-0.195
	(1.022)	(0.0976)	(2.010)	(1.234)	(0.104)	(0.483)
retail	-3.037*	-0.0532	-3.499	-5.558	-0.0887	-0.211
	(1.688)	(0.0956)	(2.335)	(20.44)	(0.101)	(0.518)
light industrial	11.59***	0.106	-4.443**	12.50***	0.0981	-1.331**
	(1.728)	(0.0998)	(1.861)	(2.185)	(0.106)	(0.599)
			Class membership model parameters			
gender	-0.333	0.0908	-	-	-	-
	(0.252)	(0.231)				
age	0.0201**	-0.0223***	-	-	-	-
	(0.00842)	(0.00740)				
employment	0.398	0.358	-	-	-	-
	(0.275)	(0.241)				
no enough agriland	-	-	-	-0.330	-0.669***	-
				(0.237)	(0.218)	
denser development	-	-	-	0.509**	0.277	-
				(0.242)	(0.220)	
Constant	-0.799	1.841***	-	-0.144	0.840***	-
	(0.487)	(0.400)		(0.226)	(0.210)	
Class Share	0.255	0.543	0.202	0.249	0.504	0.247
			Model fit			
AIC		5561.028			5588.938	
BIC		5749.396			5762.817	
Log likelihood		-2754.514			-2770.469	
Observations	10352	10352	10352	10352	10352	10352

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

(Note: Using the data when uncertain votes are recoded as preferring additional development strategies, and project-rejectors are removed.) Source: authors.

Next we focus on the results of the RPL models of WTA. The results show that *price* (a one-time tax reduction) always has a positive effect on respondents' utility and all groups of respondents prefer the status quo over additional conversion. In the basic model, respondents indicate no preference for conversion of commercial vegetable or grain land, but they are less likely to accept the compensation for conversion of grazing land. Regarding the alternative of developed land use, respondents are more willing to convert land to light industrial use compared to retail or residential. Significant coefficients of the standard deviation indicate that the RPL model captured unobserved heterogeneity. This is consistent with the results of the Latent Class model.

The WTA models were also estimated for sub-groups of respondents. Data for respondents who felt that the compensation strategies may be actually implemented were used to estimate a model for a 'strategy believers' group. Compared to the full sample, the strategy believers group prefer conversion to residential over conversion to retail. There are no large differences in results between the full sample and the retired person group. As for different income groups, low income groups have no preferences about the type of current agricultural land use, and they prefer light industrial use over other developed land uses. High income respondents have lower preference for grazing land compared to vegetable and grain land. High income responders have obvious preferences about the type of developed land. They prefer light industrial, followed by residential, and retail. Regarding gender, males do not have consistent preferences over the type of current agricultural land use, and they are more willing to convert agricultural land to light industrial than other developed uses. While females do not have consistent preferences over the type of developed land,

they have lower preference for converting grazing land than the other agricultural land uses. The results of 'own residence' are similar to the RPL basic model, while the estimates in 'rent residence' group are considerably different. In this group, respondents have no preference between additional development and the status quo. They do not have consistent preferences over the types of developed lands or agricultural lands.

Lastly, we compare results for the different regions. Respondents from the Edmonton region and the other smaller cities do not show consistent preferences over the type of lands, but again, the significance of coefficients of standard deviation indicates the existence of high heterogeneity. Respondents from the Calgary region prefer light industrial as the alternative use.

Table 4.16 shows that most of respondents except for the 'likely to be implemented' group have no preferences between the current development trend and strategies of converting grain land to light industrial land and converting commercial vegetable land to light industrial land. MWTAs in the RPL model are higher than the values calculated from the MNL model except for the strategy of converting grain to residential use. The male group has no preference between additional conversion strategies and current development trend if the land was converted to light industrial use. The strategy with highest WMTA for both male and female is converting commercial vegetable land to residential use. Both groups most prefer conversion of livestock land into retail uses. The strategy with lowest MWTA for respondents from the Calgary region and the smaller cities is converting vegetable to residential use. Respondents from Edmonton do not have any preference between this strategy with no strategy and their lowest MWTA is for converting grain land to residential use. When it comes to different income groups, both high income and low-income groups think there are no differences between converting grain or vegetable land into light

industrial land. The MWTAs in the high-income group are mostly higher than for the basic group and low-income group. The highest MWTA in the high-income group is for converting livestock land to retail use, and the lowest is for converting commercial vegetable land to residential land. The strategy with highest MWTA in the low-income group is converting livestock land to residential use and the lowest is for converting grain land to residential use. As expected, respondents who believed these strategies would be implemented prefer those additional strategies compared with the current development trend. Their MWTAs are higher than the basic group. The strategy with the highest MWTA in this group is converting livestock land to retail use, while the strategy with lowest MWTP is converting grain land to light industrial use. Retired people seem to require more compensation than the basic group, their highest MWTA is for converting livestock to retail. In conclusion, most groups indicate the need for highest compensation for converting livestock land to retail use. Respondents who have high income or believe the conversion strategies may be implemented have higher MWTAs than other groups. MWTAs for respondents who own residence are higher than MWTAs in basic model. MWTAs for respondents who rent residence are not significant. This might indicate that renters are uncomfortable with the payment vehicle included in the scenario.

Table 4.22 summarizes the ranges of aggregate willingness to accept for farmland in all 6 study areas. MWTA for the full sample ranges from CAD$340.90 to CAD$1112.45 per household per 1000 acres, therefore, the aggregate WTA per acre in Alberta ranges from CAD$520,784 to CAD$1,699,462. The MWTA for respondents living in Edmonton regions and Calgary regions ranges from CAD$440.07 to CAD$1127.92 and from CAD$467.83 to CAD$1166.20 per household per 1000 acres respectively. Following the same formulas (MWTA / 1000 *

HHnumber) as discussed under the WTP results, the ranges of aggregate WTA for an additional conversion strategy per acre in Edmonton and Calgary are from CAD$220,977 to CAD$566,374 and from CAD$261,477 to CAD$651,807.

Table 4.16 Random Parameter Logit (RPL) Model Coefficient Estimates (WTA) (basic model, strategy believers, retired)

Attributes	RPL		Strategy believers		Retired	
	Coefficient	Coefficient (Std. Dev.)	Coefficient	Coefficient (Std. Dev.)	Coefficient	Coefficient (Std. Dev.)
price	0.000675***		0.000737***		0.000845***	
	(9.74e-05)		(0.000131)		(0.000250)	
ASC	-0.333***		-0.499***		-0.736***	
	(0.0694)		(0.0955)		(0.176)	
vegetable	0.0494	0.176	-0.00242	0.144	0.0525	-0.529
	(0.0782)	(0.335)	(0.105)	(0.311)	(0.199)	(0.630)
livestock	-0.270**	1.866***	-0.301*	1.686***	-0.884*	3.811***
	(0.121)	(0.196)	(0.157)	(0.227)	(0.497)	(0.829)
retail	-0.148	2.440***	-0.297*	1.936***	-0.442	3.074***
	(0.136)	(0.220)	(0.163)	(0.245)	(0.405)	(0.691)
light industrial	0.373***	-0.797***	0.315***	0.316	0.742***	0.875**
	(0.0885)	(0.128)	(0.110)	(0.241)	(0.229)	(0.357)
AIC	6712.539		3543.133		1156.1	
BIC	6784.988		3609.06		1211.447	
Log likelihood	-3346.2695		-1761.5665		-568.04987	
Observations	10352		5392		1872	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Using the data when uncertain votes are recoded as preferring additional development strategies, and project-rejectors are removed.

Table 4.17 Random Parameter Logit (RPL) Model Coefficient Estimates (WTA) (high income, low income, own residence, rent residence)

Attributes	high income		low income		Own residence		Rent residence	
	Coefficient	Coefficient (Std. Dev.)	Coefficient	Coefficient (Std. Dev.)	Coefficient	Coefficient (Std. Dev.)	Coefficient	Coefficient (Std. Dev.)
price	0.000790***		0.000599***		0.000708***		0.000617***	
	(0.000164)		(0.000122)		(0.000117)		(0.000181)	
ASC	-0.526***		-0.218**		-0.490***		0.0485	
	(0.117)		(0.0865)		(0.0835)		(0.127)	
vegetable	0.0706	-0.161	0.0395	-0.307	0.0545	0.322	0.0338	0.0192
	(0.132)	(0.400)	(0.0989)	(0.408)	(0.0945)	(0.269)	(0.144)	(0.981)
livestock	-0.442**	1.760***	-0.138	1.897***	-0.388**	2.019***	-0.0286	1.545***
	(0.204)	(0.330)	(0.151)	(0.240)	(0.152)	(0.242)	(0.204)	(0.309)
retail	-0.631**	2.742***	0.0906	2.184***	-0.175	2.522***	-0.0647	2.236***
	(0.258)	(0.397)	(0.160)	(0.252)	(0.165)	(0.268)	(0.242)	(0.371)
light industrial	0.357**	0.817***	0.385***	0.771***	0.488***	-0.905***	0.103	-0.521**
	(0.149)	(0.211)	(0.111)	(0.166)	(0.110)	(0.150)	(0.152)	(0.258)
AIC	2383.014		4301.788		4751.975		1944.195	
BIC	2445.25		4369.724		4821.057		2004.125	
Log likelihood	-1181.5069		-2140.8941		-2365.988		-962.0976	
Observations	3,728		6592		7392		2960	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

(Note: Using the data when uncertain votes are recoded as preferring additional development strategies, and project-rejectors are removed.) Source: authors.

Table 4.18 Random Parameter Logit (RPL) Model Coefficient Estimates (WTA) (Edmonton region, Calgary region, Other places)

Attributes	Edmonton region		Calgary region		Other places	
	Coefficient	Coefficient (Std. Dev.)	Coefficient	Coefficient (Std. Dev.)	Coefficient	Coefficient (Std. Dev.)
price	0.000527***		0.000795***		0.000742***	
	(0.000153)		(0.000153)		(0.000231)	
ASC	-0.232**		-0.403***		-0.402**	
	(0.109)		(0.108)		(0.164)	
vegetable	0.0902	0.318	0.0311	-0.0140	0.000958	0.567
	(0.125)	(0.378)	(0.122)	(0.471)	(0.191)	(0.441)
livestock	-0.248	1.561***	-0.268	2.108***	-0.332	-2.163***
	(0.176)	(0.278)	(0.200)	(0.323)	(0.303)	(0.470)
retail	-0.115	2.442***	-0.256	2.616***	-0.00982	2.033***
	(0.215)	(0.341)	(0.222)	(0.361)	(0.285)	(0.448)
light industrial	0.189	0.709***	0.574***	0.875***	0.331	0.795**
	(0.135)	(0.198)	(0.142)	(0.204)	(0.214)	(0.336)
AIC	2703.86		2795.061		1241.074	
BIC	2767.076		2858.844		1296.507	
Log likelihood	-1341.9298		-1387.5303		-610.537	
Observations	4112		4,352		1888	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

(Using the data when uncertain votes are recorded as preferring additional development strategies, and project-rejectors are removed.)
Source: authors

Table 4.19 Random Parameter Logit (RPL) Model Coefficient Estimates (WTA) (male, female)

Attributes	Male		Female	
	Coefficient	Coefficient (Std. Dev.)	Coefficient	Coefficient (Std. Dev.)
price	0.000840***		0.000542***	
	(0.000145)		(0.000132)	
ASC	-0.447***		-0.239**	
	(0.103)		(0.0939)	
vegetable	0.0324	0.272	0.0602	0.0234
	(0.116)	(0.373)	(0.106)	(0.479)
livestock	-0.206	2.022***	-0.318**	1.741***
	(0.184)	(0.283)	(0.162)	(0.258)
retail	-0.115	2.173***	-0.162	2.707***
	(0.186)	(0.289)	(0.199)	(0.321)
light industrial	0.598***	-0.682***	0.181	-0.877***
	(0.129)	(0.197)	(0.122)	(0.170)
AIC	3084.282		3635.932	
BIC	3148.946		3702.237	
Log likelihood	-1532.1412		-1807.9661	
Observations	4752		5600	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

(Using the data when uncertain votes are recorded as preferring additional development strategies, and project-rejectors are removed.)
Source: authors

Table 4.20 Estimated MWTA for Conservation Strategy in Alberta (per acre, per household, next year only) (MNL, RPL: basic model, high income, low income, retired, strategy believers)

Conservation Strategy	MNL Basic Model	RPL Basic Model	RPL High income	RPL Low income	RPL Retired	RPL Strategy believers
Grain or oilseed farming; Residential	528.67***	492.99***	666.27***	364.76***	870.58***	676.64***
Commercial vegetable farm; Residential	390.24***	419.81***	576.87***	298.7247**	808.45***	679.92***
Livestock grazing on native pasture; Residential	780.93***	893.58***	1226.06***	595.7673**	1916.87***	1084.67***
Grain or oilseed Farming; Retail	636.77***	711.86***	1464.56***	213.47	1393.78***	1079.18***
Commercial vegetable farm; Retail	498.34***	638.68***	1375.16***	147.43	1331.66***	1082.45***
Livestock grazing on native pasture; /Retail	889.03***	1112.45***	2024.35***	444.47	2440.08***	1487.20***
Grain or oilseed farming; Light industrial	-34.53	-59.69	214.1723	-278.39	-7.02	249.15*
Commercial vegetable farm; Light industrial	-172.96	-132.87	124.77	-344.42	-69.14481	252.42*
Livestock grazing on native pasture; Light industrial	217.73*	340.90*	773.96***	-47.38	1039.28*	657.17***

*** p<0.01, ** p<0.05, * p<0.1

(Note: Using the data when uncertain votes are recorded as preferring additional development strategies, and project-rejectors are removed.) Source: authors.

Table 4.21 Estimated MWTA for Conservation Strategy in Alberta (per acre, per household, next year only) (male, femela, Edmonton region, Calgary region, other places, own residence, rent residence)

Conservation Strategy	RPL Male	RPL Female	RPL Edmonton region	RPL Calgary region	RPL Other places	RPL Own residence	RPL Rent residence
Grain or oilseed farming; Residential	531.94***	441.10***	440.07**	506.97***	540.82***	692.35***	-78.50
Commercial vegetable farm; Residential	493.40***	329.98*	268.90	467.83***	539.53**	615.29***	-133.30
Livestock grazing on native pasture; Residential	777.65***	1028.55***	910.55**	843.96***	988.38**	1240.98***	-32.11
Grain or oilseed Farming; Retail	668.75***	740.88**	657.44*	829.20***	554.05	939.06***	26.40
Commercial vegetable farm; Retail	630.21***	629.75*	486.27	790.06***	552.76	862.00***	-28.39
Livestock grazing on native pasture; /Retail	914.45***	1328.33***	1127.92**	1166.20***	1001.61*	1487.69***	72.79
Grain or oilseed farming; Light industrial	-180.00	107.10	81.019	-214.26	94.65	2.79	-244.95
Commercial vegetable farm; Light industrial	-218.55	-4.03	-90.15	-253.40	93.36	-74.26	-299.74
Livestock grazing on native pasture;	65.70	694.55**	551.51	122.73	542.21	551.43**	-198.56

*** p<0.01, ** p<0.05, * p<0.1 (Note: Using the data when uncertain votes are recorded as preferring additional development strategies, and project-rejectors are removed.) Source: authors

Table 4.22 Ranges of Aggregate WTA

	Lowest WTA (CAD$ per acre))	Highest WTA (CAD$ per acre)
Grande Prairie	23,450,000	23,487,755
Edmonton	220,977,000	566,374,000
Red Deer	39,705,000	39,768,925
Calgary	261,477,000	651,807,000
Lethbridge	45,695,000	45,768,569
Medicine Hat	26,460,000	26,502,601

Source: authors.

4.5.3. Comparison of WTP and WTA

One of the initial objectives of this study was to compare WTP and WTA approaches for evaluating farmland conservation and development in Alberta. This section provides that comparison.

First, we note that fair comparison of results would be most credible if we held as many things as possible constant across the WTP and WTA surveys. Thus, in both surveys we provided the same background information, asked the same preliminary questions, asked the same demographic questions, and asked nearly identical follow up questions. The scenarios used the same visuals to illustrate the land use change scenarios and we used the same payment range in the WTP and WTA surveys. We also requested the survey companies to use the same procedures to select respondents into the WTP and WTA surveys, and to run the surveys at the same time. In all of those regards, our only real concern is the different percentages of women and men who provided complete responses to the two surveys. As mentioned in section 4.2, a higher percentage of women

answered the WTP survey than answered the WTA survey. Here we compare indicators of the credibility of the surveys, as well as results.

28 WTP respondents (4.36%) and 13 WTA respondents were identified as project-rejectors (1.97%). The number of WTP project rejectors is slightly higher than WTA, although still relatively low. Overall, we conclude that most respondents accepted the plausibility of both the WTP and WTA scenarios. Secondly, from the follow up question, we found that 54.9% of respondents believed that the WTP conservation strategies are likely or very likely to be implemented and 51.5% of respondents believed that the development strategies are likely or very likely to be implemented. The rate of strategy believers was thus slightly higher for WTP than for WTA. We postulate that this difference may reflect differences in people's understanding of the consistency of scenarios with de facto property rights. As discussed in section 1.2 above, the Alberta Land Use Framework and Municipal Government Act make it clear that private land rights are limited and that municipalities should consider the public interest in allowing changes in zoning. In practice, however, many farm owners believe that they have a right to convert their land to more developed uses and many municipal governments are reluctant to deny applications for land re-designation. Municipal land use plans are not strictly followed, and municipal governments are not held to account for complying with those plans.

A third indicator of the survey method was the percentage of respondents who indicated "uncertain" or "very uncertain" in their reactions to the scenarios. Respondents to the WTP survey who were uncertain of their responses were assumed to prefer the status quo of no conservation and were recoded accordingly. The percentage of uncertain responses for WTP was 8.6%. Respondents to the WTA survey who were uncertain of their responses were assumed to prefer

the development strategy and were recoded accordingly. The percentage of uncertainty rate for WTA was 15.3%. Thus, we conclude that respondents in the WTP case were more confident with their answers than respondents in the WTA case.

To illustrate the differences between estimates of WTA and WTP, Table 4.23 shows the ratios of MWTA/MWTP for the nine strategies across different groups of respondents. As indicated in Chapter 2, both psycho-economic theory and empirical studies indicate that WTA will be larger than WTP. For the 76 studies that they considered, Tuncel and Hammitt (2014) found the average ratio to be about 3 across all goods, 6.23 for environmental goods, and 3.93 for other public or non-market good. From table 4.23, we found that the ratio of WTA to WTP ranges from 0.88 to 3.05, which is lower than the average ratio found in previous studies. The lowest ratios in all groups is for the vegetable-residential land use change which has relatively high MWTPs and low MWTAs, while the highest ratios among all groups are for the livestock-retail land use change, which has quite high MWTAs.

It is noteworthy that we found WTA / WTP values that are less than 1. For the 'strategy believers' group, grain-vegetable and livestock-light industrial are only 0.34 and 0.3, respectively, which means that MWTA is much smaller than MWTP. A potential reason is that although MWTA in these two categories are significant, the p values are just at the 10% level. Other results with MWTA / MWTP ratios less than 1 are for conserving vegetable land from being converted into residential and converting vegetable land to residential use.

The MWTA / MWTP ratios from male and female are very similar. The ratios for the Edmonton groups are smaller than the ratios for the Calgary groups. The gap for the retired group is larger than the gap for the basic group.

Table 4.23 WTA/WTP ratios in different groups

WTA/WTP	RPL	Male	Female	Edmonton	Calgary	Other place	High income	Low income	Strategy believers	retired	Own residence	Rent residence
Grain-residential	1.21	1.45	1.03	1.03	1.18	1.86	1.45	1.00	1.14	1.58	1.75	/
Vegetable-residential	0.88	1.04	0.69	/	1.06	1.36	1.10	0.68	0.98	0.98	1.42	/
livestock-residential	2.43	2.06	2.74	1.87	2.60	/	3.09	1.68	2.30	3.22	3.29	/
grain-retail	1.76	2.39	1.59	1.52	1.92	/	3.03	/	1.61	2.27	2.49	/
vegetable-retail	1.35	1.63	1.21	/	1.79	/	2.51	/	1.40	1.50	2.08	/
livestock-retail	3.05	3.14	3.19	2.28	3.57	/	4.83	/	2.70	3.70	4.15	/
grain-light industrial	/	/	/	/	/	/	/	/	0.34	/	/	/
vegetable-light industrial	/	/	/	/	/	/	/	/	0.30	/	/	/
livestock-light industrial	1.00	/	1.76	/	/	/	2.52	/	1.08	1.73	1.62	/

If MWTA or MWTP is insignificant , no ratio results are recoded

4.6. Robustness Tests for Results

We performed robustness tests after estimation of the original WTP and WTA models. Firstly, we used the STATA robust standard error estimation to test for the existence of heteroscedasticity. The estimation results were unchanged from the original model. We thus conclude that the random errors in the models have homogeneous variance.

Second, we ran the models without recoding uncertainty votes. The signs of all parameters are consistent with previous results for both the WTP and WTA cases. We can see the changes from the result (Appendix D). For WTP, we see that respondents are more likely to say "yes" to the conservation strategy due to increase of magnitude of parameter of ASC. The estimate of the parameter for "Vegetable" changed from insignificant to significant, which means that respondents are more willing to vote for conservation strategy if farmland is commercial vegetable land. The MWTP values also increase. For WTA, the magnitude of the ASC parameter increased indicating that respondents are less inclined to vote "yes" for the development strategy. The sign on "Vegetable" changed from insignificant to significant at the 10% level. "Retail" turns to strongly significant, indicating that respondents prefer conversion to residential over retail. The MWTA values also increase. Otherwise, the results are similar to the results from the original coding.

Third, we tested effects of different sample sources on the results. As mentioned above, Qualtrics worked with two local panels with a balanced blend of sample sources. Therefore, we added a binary variable to represent one of the panels in both WTP and WTA models. The results in both models show that the estimates of the binary variables are not significant, which suggests that there is no statistical difference between the results generated for the two panels.

4.7. Follow-up Questions/ Debriefing

Debriefing questions were included in the survey to further explore respondents' attitudes toward the attributes and strategies. For the WTP survey, around 70% of respondents thought that types of current agricultural use and the one-time additional increase in property tax or rent to each taxpayer in their areas were important or very important attributes of the scenarios. 65% of respondents thought that the types of urban development without conservation were important or very important. 38.57% of respondents indicated that the level of payment was very important. While only 15.55% and 18.35% of WTP respondents indicated that current agricultural land use and alternative developed land use were very important for their decisions.

Table 4.24 Respondents' Attitude towards Each Attributes (N=643 for WTP)

Attribute	Percentage				
	Not at All Important	Unimportant	Neither Unimportant nor Important	Important	Very important
Type of Current Agricultural Use	2.95%	8.24%	18.97%	54.28%	15.55%
Type of urban development without conservation	5.29%	8.86%	21.31%	46.19%	18.35%
One-time additional increase in property tax or rent to each taxpayer in your area ($)	3.27%	4.98%	15.09%	38.10%	38.57%

Results for the WTA respondents were considerably different. 79% and 75% of respondents indicated that the type of current agricultural use and type of replacement urban development, respectively, were important or very important. Only 45% of respondents thought that the one-time additional reduction property tax or rent to each taxpayer in their area was important or very important.

In conclusion, WTA respondents seemed were less interested in the price attribute relative to WTP respondents and were more interested in the type of replacement development. This is consistent with our finding that there is smaller variation between different levels of price for WTA respondents in non-parameter analysis comparing with WTP respondents.

Table 4.25 Respondents' Attitude towards Each Attributes (N=660 for WTA)

Attribute	Percentage				
	Not at All Important	Unimportant	Neither Unimportant nor Important	Important	Very important
Type of Current Agricultural Use	3.33%	4.24%	13.64%	57.27%	21.52%
Type of replacement urban development	3.33%	5.91%	15.76%	48.64%	26.36%
One-time additional reduction in property tax or rent to each taxpayer in your area	11.52%	14.24%	29.09%	30.91%	14.24%

Respondents who voted for the conservation/development strategies were required to indicate which aspect is most important to them with respect to the agricultural use conserved/ developed

uses. For the conservation strategy, the highest percentage (37%) is 'food for local market'. Around one quarter of respondents think the most aspect is food for national/global market, and almost the same percentages of respondents consider water or air quality to be the most important aspect. These results indicate that food security and the food industry are primary concerns for residents who are interested in conserving land in agriculture. Environmental services, or "green infrastructure," is of less concern. From the answers to the initial background questions, it may be that respondents are more likely to associate environmental services with natural areas than farms. For the conversion strategy, 'increase local employment' accounts for the highest percentage (39%). The percentages of the other four aspects are quite similar. These results are consistent with the preference for light industry found in the WTA results. Respondents might assume that light industry generates more employment than the other developed uses, and that light industry is well situated within 10 km of current urban areas.

Table 4.26 Most Important Aspect to Respondents with Respect to Conservation/ Conversion Strategy

Conservation Strategy		Conversion Strategy	
Most important aspect	percentage	Most important aspect	percentage
Food for local market	37%	Increase local employment	39%
Food for national/global market	26%	Increase property tax revenue	15%
Water or air quality	25%	Expansion of public services	15%
Recreation	4%	Easier access to consumer goods	12%
Scenic beauty	9%	More available housing	19%

Chapter5. Summary and Conclusions

5.1. Introduction

Worldwide, protection of farmland has aroused an expanding array of farmland protection programs or policies. This thesis examines farmland conservation and conversion and evaluates public values of farmland for the case of Edmonton, Calgary, Lethbridge, Red Deer, Grande Prairie, and Medicine Hat regions of Alberta, Canada. In the last three decades, Alberta has experienced rapid population growth and economic development. Alberta's public and private lands are becoming more highly fragmented and contested, losing ecosystem service values. Due to urban sprawl, some of the province's most productive agricultural land has been converted to residential, light industrial and retails uses. The lost farmlands provide not only market commodities, but also valuable environmental services. Many of these services are public goods whose value cannot be estimated directly from market data; therefore, we use a choice experiment to estimate these non-market values. Alberta has no specific policy or program to protect agricultural land. Provincial policies encourage municipal governments to protect prime agricultural land when considering specific applications to re-zone land. But neither provincial nor municipal governments have good information on which to base their decisions. Therefore, the general objective of our study is to inform decision makers about the values gained or lost when land is converted from agriculture to other uses. Residents' willingness-to-pay (WTP) to protect land in agricultural uses and willingness-to-accept (WTA) compensation for the loss of farmland due to development are valued. We also identify and quantify sources of variation in WTP and WTA.

The following sections of this chapter summarize our approach and findings, provide policy implications, and discuss limitations and further research extensions.

5.2. Background and Methods

Chapter 2 reviews relevant literature, government policies toward farmland conservation in and outside of the province of Alberta, and the stated preference method and theory behind it. Coase (1960) considers "the problem of social cost" when actions by one economic agent produce externalities for another economic agent. He argues that if private exchange of property rights can be undertaken with zero transaction cost, and property rights are initially assigned clearly, then the two economic agents will bargain until the same resource allocation is achieved. For our case, the Coase Theorem implies that the same amounts of land would be cultivated or converted, no matter whether farmers had the initial right to convert as much as land as they want, or if those who benefit from open space have the initial right to fully benefit from the open space benefits that farmland provides. However, the conditions of the Coase Theorem rarely, if ever, hold in practice. Loss aversion, endowment effects, transaction costs and incomplete information are prevalent. In our case we focus on limits to the private rights to farmers to convert land to non-agricultural uses, and limits on the rights of the public to the benefits that farmland provides. While the WTP scenario implicitly assumed that farmers have complete rights to convert, the reality in Alberta is that this private right is limited by the public interests in the land being kept in agriculture. Alternatively, while the WTA scenario implicitly assumed that the public has the rights to continue to enjoy the benefits of the farmland, the reality is that this public right is limited by the magnitude of the public interest and the need to allow continued reasonable use of the land. There may also

be differences between rights as defined by formal statute and de facto rights established by precedent and expectation.

This study shows that revealed preference (especially hedonic prices) and stated preference methods can be used to evaluate the non-market values that farmland generates. Choice experiments can provide values for changes in single attributes and for different levels of attributes, offering insights on how people trade off different levels of attributes (Holmes et al., 2017). Following the theoretical foundation of the random utility model, respondents' willingness to pay and willingness to accept can be evaluated by multinomial logit model, latent class model, and random parameter logit model (Bockstael and McConnell, 2007).

This paper makes a contribution to the literature on non-market valuation by estimating and comparing values generated from WTP and WTA approaches through side-by-side studies, using the up-to-date survey and analytical methods. Chapter 3 mainly describes the methods and procedures used for assessing WTP for farmland conservation and WTA for compensation for farmland conversion. Attributes, attribute levels, alternative identification, experimental design, questionnaire development, focus groups, pretest and soft launch, data collection, and the econometric models are elaborated. In each survey, respondents are required to consider whether they prefer the current development trend to an additional conservation or additional development strategy. The additional strategies include 3 attributes. The current agricultural use can be grain or oilseed farming, livestock grazing on native pasture, or commercial vegetable farm. The replacement urban development can be residential, retail or light industrial. A one-time change in property tax or rent in the next year could range from $50 to $1000. An efficient design is used. as experiment design. A 'certainty question' is used to distinguish uncertain answers. Respondents

are informed that we will share the results with local and provincial governments and that the strategy could be actually used in policy making by those authorities. After ethics approval, we convened focus groups in two study areas to refine the scenarios and finalize the questions for the online surveys. Then, the online surveys were pre-tested with volunteers. Before surveys were sent out to the full sample of respondents, a soft launch was implemented to get some preliminary results. A full launch of the online survey was conducted with around a thousand and three hundred respondents. Respondents were randomly sorted into two equal groups, half of whom completed the WTA version of the survey and half of whom completed the WTP version.

5.3. Summary of Results

Chapter 4 presents results generated from the WTP and WTA surveys in a sequence of steps. Firstly, from background information responses, according to the people's perception of land in agricultural uses and urban growth around their residence, the large majority of respondents appreciated the food production value of farmland, smaller majorities of respondents appreciated the environmental and amenity values of farmland. 78% of respondents think enough or too much land is set aside for urban growth. More respondents prefer conserving additional amounts of natural lands than additional amounts of agricultural lands. Also, more than 50% of respondents prefer denser forms of urban development that would reduce pressure to convert surrounding farmland. From non-parametric analysis, around 58% of the WTP respondents were willing to pay the stipulated amount ($50-$1000) toward the farmland protection. 72% of WTP respondents were willing to make a one-time contribution of lowest cost level ($50) toward that conservation, while 40% of them were willing to make a one-time contribution at the highest cost level ($1000). Only 31% of respondents were willing to receive the stipulated levels of compensation for development

strategies. Respondents preferred protecting land for vegetables and grain over livestock grazing. Respondents preferred conversion to light industrial over conversion to retail or residential. 40% of respondents indicated that they would be willing to accept a one-time tax reduction of $1000, while 27% would be willing to allow that development in return for a one-time tax reduction of $50. When it comes to choice experiment results, there were no consistent preferences for type of farmland or type of developed land in the WTP study. However, the different results across the classes in latent class model and statistically significant standard deviation coefficients in random parameter logit model indicate that respondents have highly heterogeneous preferences over attributes in the model. In the WTA survey, respondents had highest WTA for conversion of livestock grazing land. Respondents preferred conversion to light industrial over retail or residential.

The latent class model results show that the majority of respondents (65-80% depending on the model) who are willing to pay for farmland conservation or would require compensation to allow additional farmland to be developed. This majority group might be most willing to accept limitations on private rights to convert land out of agriculture. However, the results from both models show that there is a core of individuals (20-35%) who resist the idea of paying for farmland conservation or receiving payment from developers. This core group might be least willing to accept limitations on private rights to convert land out of agriculture.

For the full samples, MWTP ranges from CAD$340.15 to CAD$475.90, and MWTA ranges from CAD$340.90 to CAD$1112.45 per household per 1000 acres for the next year only. People living in Edmonton are willing to pay more for protection of agricultural land than people living in other places. Females have higher willingness to pay and willingness to accept than males. People with

high income are willing to accept a high amount as compensation for losing agricultural land. People who believe the strategies are likely or very likely to be implemented are willing to pay more to protect farmland. Retired people are willing to pay and accept much more than others. For the full sample, WTA was about 62% greater than WTP. The areas potentially conserved in the Edmonton and Calgary regions are 42,238 and 28,996 acres.

5.4. Implications

This paper contributes to the literature in three main ways. First, the paper is one of a limited number of papers that have used choice experiment methods to estimate and compare WTP and WTA values. WTA estimates obtained through the contingent valuation method (CV) were not considered to be reliable but using WTA has been confirmed as theoretically valid in studies using the choice experiment method (CE). The results indicate that we should expect a certain percentage of respondents to reject both the conservation and development scenarios. In this case, I don't know why. Was it due to the implicit property rights assumption, the payment / tax mechanisms (anti-tax), or a real focus on land use? We should also expect respondents to expect some amount of uncertainty. The way that uncertain responses are coded has significant effects on the results.

Second, the results of the WTP and WTA analysis will be a useful contribution to debates about land use and agricultural land conservation in Alberta and elsewhere. Overall, the majority of respondents believe that there is substantial public value in maintaining agricultural land around urban areas. The next challenge is to identify and quantify the public interests in certain types and locations of agricultural land. Such analysis would be necessary for the design of programs such as transfer of development credits.

Third, the results will contribute to land use planning and farmland conservation for Alberta municipalities and provincial government. The results, especially using the Latent Class Model, show that heterogeneity in respondents' preferences is likely to arise in public debates and cause different stakeholders to react differently to new government programs, land trusts, and land development. Government programs might be designed to account for the sources of heterogeneity of WTP and WTA. For example, tax or rebate levels might be progressive, with taxation or rebate rate linked to income levels so that more wealthy people pay more than those who are less wealthy.

5.5. Limitations and Future Research

There are some potential limitations in this research. Firstly, although the total numbers of our study population are sufficient for estimation of non-market values, the samples in the regions except for Edmonton and Calgary are still very small. Therefore, the estimates from subgroups of those regions are not robust due to low population, and the representativeness of the survey sample is a matter of concern. Secondly, for the full sample, the number of women is higher than the number of men, with significantly different proportions of women and men between the WTP and WTA samples. We know of no logical reason for why this imbalance occurred. However, this may not affect results too much because gender is not statistically significant in the latent class models. Thirdly, only current agricultural land, replacement urban development and one-time changes in property tax or rent are considered as attributes. This simple design may have excluded factors that would have been important in respondents' decisions. Fourthly, the bid levels in both surveys range from $50-$1000. However, we found that some of the willingness to accept values are outside the range of our bids and the highest amount offered convinced fewer than half of the

respondents to accept compensation in the WTA scenario. The upper value of the bid range may have been too low, although a higher bid may not have been credible.

There could be three types of future extension from this study. Firstly, the results and contextual information for decision makers could be packaged for consideration by policy makers in the 6 relevant communities. Secondly, we recommend further analysis of the WTP and WTA results to better understand sources of heterogeneity, for example current land use in areas around respondents' residences. Thirdly, we recommend the collection of new WTP and WTA data with a wider bid range, more equal gender balance, and possible additional attributes.

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Appendix

Appendix A: The syntax for the D-efficient design in Ngene:

```
Design;
alts = alt1, alt2
;rows = 16
;block = 2
;eff = (mnl,d)
;alg=mfederov
;model:
U(alt1) = b2 * A[0,1,2] + b3 * B[0,1,2] + b4 * C
[50,100,300,600,1000]/
U(alt2) = b1
$
```

Appendix B: Information Sheet

INFORMATION SHEET

Title of Study: Urban development and conservation of land in Agricultural Uses (Pro 00085639)
Principal Investigator:

Brent Swallow, Professor
567 General Services Building
Tel: (780) 492-6656
brent.swallow@ualberta.ca

Why are you being asked to take part in this research study?
A market research firm has selected you to participate in this study based on the location of your residence and your indication that you are willing to be involved in a focus group. You are being asked to participate in this study so that we can gather public opinions about the future of land use in Alberta.

What is the purpose for doing the study?
The purpose of this project is to better understand the attitudes of Alberta residents regarding conservation and development of land that is currently in agricultural uses. This research aims to identify agricultural uses that are particularly valuable to the public interest and developed uses that are of particular concern.

Please note that this study is not focusing on the market value of land, but on the non-market values that are associated with different agricultural and developed uses.

The answers and preferences expressed by the survey respondents will be analyzed. Data and

results will be used for academic reports, papers and graduate theses. Results will also be conveyed to the public and government authorities in Alberta.

Who is conducting this study?
Professors and graduate students from the University of Alberta are conducting this study. The study is funded by the Alberta Land Institute and the Alberta Real Estate Foundation. The Alberta Land Institute is an independent, non-partisan research institute based at the University of Alberta. The Alberta Real Estate Foundation supports and originates initiatives that enhance the real estate industry and benefit Alberta.

What will you be asked to do?
We want your feedback on an internet survey that we are planning to implement with rural and urban residents of Alberta's four most populous metropolitan areas. It is important that all respondents understand the questions we ask. We want you to read the background information and questions as if you had agreed to participate in the online survey. Please let us know if any of the information or questions are unclear, ambiguous or misleading. Different people have different background and perceptions, so please discuss the issues with other members of the focus group. We expect the focus group to last for approximately 90 minutes. Each focus group will be audio recorded to ensure accuracy.

What are the risks and discomforts?
There are no known risks beyond those you encounter in everyday life.

What are the benefits to you?
You will receive no direct benefits from participation in this study, other than compensation as agreed with the survey company. Indirect benefits might arise if governments in your region change policies or regulatory practices on the basis of this research.

Do you have to take part in the study?
Participation in this study is voluntary. If you decide not to participate in the focus group, you can change your mind and stop at any time. You may also choose not to answer any particular question.

Will you be paid to be in the research?
You will be compensated for your time and travel at the completion of the focus group.

Will your information be kept private?
Your name and contact information will not be collected, and your individual responses will not be shared with anyone. Your comments and ideas will not be related back to you in any way. Once submitted, data cannot be withdrawn. All data uses will be in compliance with the *University of Alberta Standards for the Protection of Human Research.* Results will not in any way be associated with personal information. At the University of Alberta, we keep data stored for 5 years after the

end of the study.

What if you have questions?
The plan for this study has been reviewed by a Research Ethics Board at the University of Alberta. If you have questions about your rights or how research should be conducted, you can call (780) 492-2615. Refer to Research Protocol Number Pro00085639. This office is independent of the researchers.
If you have any questions about the research now or later, please contact the principal investigators: Brent Swallow at (780) 492-6656.

Appendix C: Consent Form Checklist

January 2019
Researchers: Brent Swallow
Yicong Luo

Urban development and conservation of land in Agricultural Uses (Pro 00085639)

Focus Group Consent
Investigators:
Brent Swallow, University of Alberta, +1-780-492-6656
Yicong Luo, University of Alberta, +1-780-655-8609

Consent: (oral response and recorded by investigator)

Please record the response of the participant to the following questions by circling	YES or NO	
Do you understand that you have been asked to be in a research study?	YES	NO
Do you understand the purpose of the research study?	YES	NO
Do you know what the information you provide will be used for?	YES	NO
Do you understand the benefits and risks involved in talking part in this study?	YES	NO
Do you understand that you can stop taking part in this study at any time?	YES	NO
Has confidentiality been explained to you?	YES	NO
Do you agree to keep what is said in the focus group confidential?	YES	NO
Do you understand who will be able to see or hear what you said?	YES	NO
Do you give us permission to use your data for the purpose specified?	YES	NO
Do you consent to being audio- taped?	YES	NO

This Study was explained to me by: _____

Participant's Printed Name

I am confident that I have explained to the participant what is involved in participating in this study and they have voluntarily agreed to participate through oral consent.

---------- ----------
Investigator Signature Date

Appendix D: Random Parameter Logit Model (RPL) Coefficient Estimates (WTA) (no recoding)

Random Parameter Logit Model (RPL) Coefficient Estimates (no recoding)

	Full Sample (WTP)		Full Sample (WTA)	
Variables	Mean	SD	Mean	SD
price	-0.00186***		0.000849***	
	(0.000117)		(9.76e-05)	
ASC	1.119***		-1.087***	
	(0.0810)		(0.0747)	
vegetable	0.272**	1.732***	0.134*	0.0192
	(0.120)	(0.189)	(0.0781)	(0.117)
livestock	0.208	1.663***	-0.601***	1.744***
	(0.130)	(0.188)	(0.135)	(0.185)
retail	0.145	1.819***	-0.567***	2.009***
	(0.123)	(0.183)	(0.139)	(0.194)
industrial	0.0592	1.669***	0.404***	-0.00790
	(0.128)	(0.180)	(0.0804)	(0.146)
Observations	9,840	9,840	10,352	10,352

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix E: Online Surveys

Default Question Block

Before you proceed with the survey, we need to ensure that you are an eligible respondent. Please answer the following three questions.

Are you 18 years old or older?

- ○ Yes
- ○ No

Are you a homeowner or renter?

- ○ Yes
- ○ No

Where do you currently reside?

- ○ Edmonton region
- ○ Calgary region
- ○ Lethbridge region
- ○ Red Deer region
- ○ Medicine Hat region
- ○ Grande Prairie region

○ None of the above

A Survey about

Urban Development and Conservation of Land in Agricultural Uses in Alberta (Part A)

Alberta Land Institute

PARTICIPANT CONSENT FORM

Title of Study: Urban development and conservation of land in Agricultural Uses (Pro 00085639)

Principal Investigator:

Brent Swallow, Professor
567 General Services Building
University of Alberta
Tel: (780) 492-6656
brent.swallow@ualberta.ca

Why am I being asked to take part in this research study?

A survey company has selected you to participate in this study based on the location of your residence and your willingness to be involved in a survey. You are being asked to participate so that we can gather public opinions about the future of land use in Alberta.

What is the purpose of this study?

The purpose is to understand the views of Alberta residents regarding the conservation and development of land in agricultural uses. We want to identify agricultural uses that are particularly valuable to the public interest and developed uses that are of particular concern. This study is funded by the Alberta Land Institute and the Alberta Real Estate Foundation. The Alberta Land Institute is an independent, non-partisan research institute based at the University of Alberta. The Alberta Real Estate Foundation supports and originates initiatives that enhance the real estate industry and benefit Alberta.

Data and results will be used for academic reports, papers, and graduate theses. Results will also be conveyed to the public and government authorities

in Alberta.

What will I be asked to do?

You will be asked questions on various topics regarding land use. The survey should take about 30 minutes.

What are the risks and discomforts?

There are no known risks beyond those you encounter in everyday life.

Will I be paid to be in the research?

There will not be direct payment for your participation. You will be compensated by the survey company once you have completed.

What are the benefits to me?

You will receive no direct benefits from participation in this study, other than the compensation provided by the survey company. Indirect benefits might arise if governments in your region change policies or regulatory practices on the basis of this research.

Do I have to take part in the study?

Participation in this study is by choice. If you decide not to be involved, you can change your mind and stop at any time.

Will my information be kept private?

Your name and contact information will not be collected, and your individual responses will not be shared with anyone. Your comments and ideas will not be related back to you in any way. Once submitted, data cannot be withdrawn. All data use will comply with the University of Alberta Standards. At the University of Alberta, we keep data stored for 5 years after the end of a study.

What if I have questions?

The plan for this study has been reviewed by a Research Ethics Board at the University of Alberta. If you have questions about your rights or how research should be conducted, you can call (780) 492-2615. Please refer to Research Protocol Number Pro00085639. This office is independent of the researchers.

If you have any questions about the research now or later, please contact the principal investigator: Brent Swallow at (780) 492-6656 or brent.swallow@ualberta.ca.

Consent

If you consent to participate in the experiment, please click on the "Next" symbol to start the survey. Please note that once you advance by clicking "Next" you cannot go back and revise your answers. If you don't consent to participate in the experiment, please click on the "Exit" symbol to finish the survey.

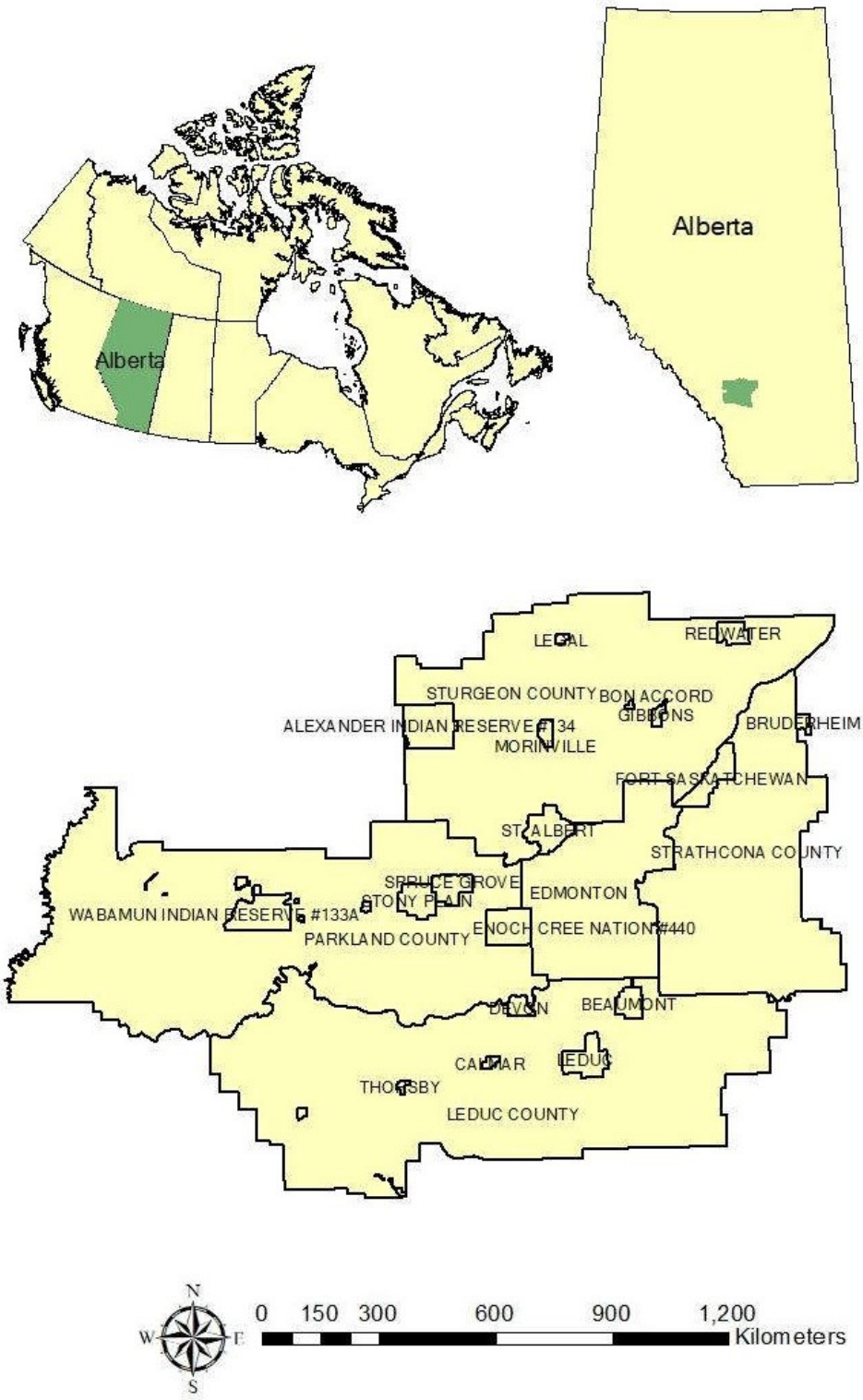
- ○ Next
- ○ Exit

Background

We are directing this survey to residents of the 6 regions listed on the opening page. The list includes 3 Census Metropolitan Areas (CMAs) and 3 Census Agglomerations (CAs). Both CMAs and CAs comprise one or more adjacent

municipalities centered on a core population center. To begin the survey, we provide some background information about your region.

In 2016, the population of the Edmonton census metropolitan area was 1,321,426, which represents an increase of 13.9% from 2011. This compares to the provincial average increase of 11.6% and the national average increase of 5.0%. The Edmonton census metropolitan area (CMA) covers 9,438.86 square kilometers. The population density was 140.0 people per square kilometer in 2016.

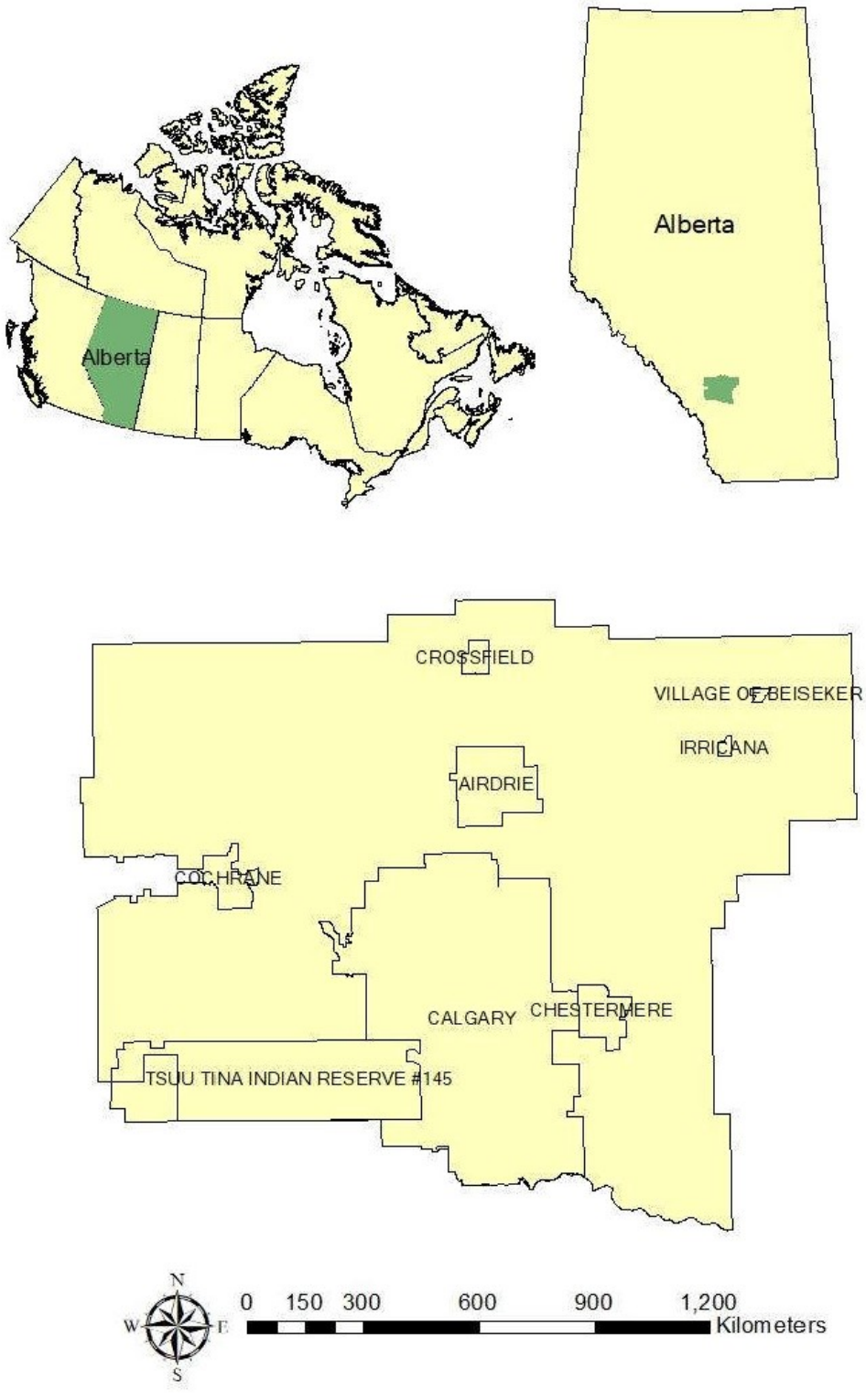

Alberta
Alberta
LEGAL
REDWATER
STURGEON COUNTY
BON ACCORD
GIBBONS
ALEXANDER INDIAN RESERVE #134
MORINVILLE
BRUDERHEIM
FORT SASKATCHEWAN
ST. ALBERT
STRATHCONA COUNTY
SPRUCE GROVE
STONY PLAIN
EDMONTON
WABAMUN INDIAN RESERVE #133A
PARKLAND COUNTY
ENOCH CREE NATION #440
DEVON
BEAUMONT
CAMROSE
LEDUC
THORSBY
LEDUC COUNTY
N
W
E
S
0 150 300 600 900 1,200
Kilometers

The Edmonton census metropolitan area (CMA) includes the following 35 census subdivisions (municipalities or municipality equivalents):

- 5 cities: Edmonton, Fort Saskatchewan, Leduc, St. Albert, and Spruce Grove
- 1 specialized municipality: Strathcona County
- 3 municipal districts: Leduc County, Parkland County, and Sturgeon County
- 11 towns: Beaumont, Bon Accord, Bruderheim, Calmar, Devon, Gibbons, Legal, Morinville, Redwater, Thorsby, and Stony Plain
- 3 villages (Spring Lake, Wabamun, and Warburg)
- 8 summer villages: Betula Beach, Golden Days, Itaska Beach, Kapasiwin, Lakeview, Point Alison, Seba Beach, and Sundance Beach
- 4 First Nation Reserves: Alexander 134 of the Alexander First Nation, Stony Plain 135 of the Enoch Cree First Nation, and Wabamun 133A and 133B of the Paul First Nation.

In 2016, the population of Calgary census metropolitan area (CMA) was 1,392,609, which represents an increase of 14.6% from 2011. This compares to the provincial average of 11.6% and the national average increase of 5.0%. The land area of the Calgary census metropolitan area is 5,110.21 square kilometers and the population density was 272.5 people per square kilometer in

2016.


Alberta
Alberta
CROSSFIELD
VILLAGE OF BEISEKER
IRRICANA
AIRDRIE
COCHRANE
CALGARY
CHESTERMERE
TSUU TINA INDIAN RESERVE #145
N
W
E
S
0 150 300 600 900 1,200
Kilometers

The Calgary census metropolitan area, as defined by Statistics Canada, includes the following nine municipalities:

- 3 cities: Airdrie, Calgary, and Chestermere
- 1 municipal district: Rocky View County
- 3 towns: Cochrane, Crossfield, and Irricana
- 1 village: Beiseker
- 1 First Nations reserve: Tsuu T'ina Nation

In 2016, the population of the Lethbridge census metropolitan area (CMA) was 117,394, which represents an increase of 10.8% from 2011. This compares to the provincial average increase of 11.6% and the national average increase of 5.0%.

The land area of the Lethbridge census metropolitan area is 2,975.08 square kilometers and the population density was 39.5 people per square kilometer in 2016.


Alberta
Alberta
BARONS
NOBLEFORD
PICTURE BUTTE
COALHURST
COALDALE
N
W
E
S
0 100 200 400 600 800
Kilometers

The Lethbridge census metropolitan area, as defined by Statistics Canada, includes the following nine municipalities:

- 1 city: Lethbridge
- 1 municipal district: Lethbridge County
- 3 towns: Coaldale, Coalhurst and Picture Butte
- 2 village: Nobleford and Barons

In 2016, the population of the Red Deer census agglomeration (CA) was 100,418, which represents an increase of 10.9% from 2011. This compares to the provincial average increase of 11.6% and the national average increase of 5.0%.

The land area of Red Deer is 104.7 square kilometers and the population density was 958.8 people per square kilometer in 2016.


Alberta
Alberta
Red Deer
N
W
E
S
0 100 200 400 600 800
Kilometers

In 2016, the population of the Medicine Hat census agglomeration (CA) was 76,522, which represents an increase of 5.1% from 2011. This compares to the provincial average increase of 11.6% and the national average increase of 5.0%.

The land area of Medicine Hat is 13,301.54 square kilometers and the population density was 5.8 people per square kilometer in 2016.


Alberta
Alberta
REDCLIFF
MEDICINE HAT
N
W
E
S
0 100 200 400 600 800
Kilometers

The Medicine Hat census agglomeration (CA), as defined by Statistics Canada, includes the following three municipalities:

- 1 city: Medicine Hat
- 1 municipal district: Cypress County
- 1 town: Redcliff

In 2016, the population of the Grande Prairie census agglomeration (CA) was 63,166, which represents an increase of 13.5% from 2011. This compares to the provincial average increase of 11.6% and the national average increase of 5.0%.

The land area of Grande Prairie is 132.73 square kilometers and the population density was 475.9 people per square kilometer in 2016.


Alberta
Alberta
CITY OF GRANDE PRAIRIE
N
W
E
S
0 100 200 400 600 800
Kilometers

Section A To begin with the survey, we ask a few questions about agricultural land use

Land can be used for extensive (e.g. field crops, pastures for cow-calf operations) and intensive (e.g. confined feeding operations, greenhouse, market gardens) agriculture. Land can also be converted from agriculture to urban uses (residential, industrial, or retail).

These land uses generate four categories of ecosystem goods and services:

- Provisioning Services, such as food, fresh water, and minerals
- Regulating Services, such as water purification, flood control, and pollination
- Cultural Services, such as aesthetics, recreation, and education
- Supporting Services, such as soil formation and biodiversity conservation

Question 1

1a. Please indicate what you think of the following statements by clicking the button that best describes your level of agreement or disagreement.

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Agree	Strongly agree
The primary function of land					

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Agree	Strongly agree
in agricultural uses is to produce food	○	○	○	○	○
Land in agricultural uses helps to clean air and water	○	○	○	○	○
Land in agricultural uses conserves the diversity of natural systems	○	○	○	○	○
Land in agricultural uses provides social benefits such as recreational opportunities	○	○	○	○	○

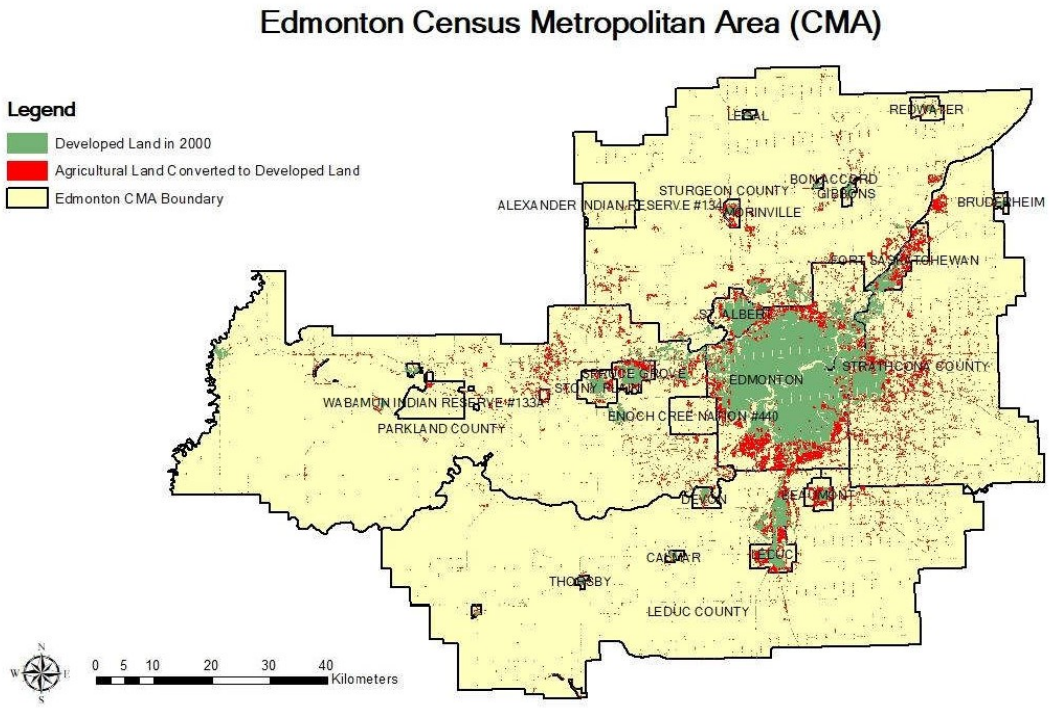
1b. Please indicate what you think of the following statements by clicking the button that best describes your level of agreement or disagreement.

	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
It is important to maintain land in agricultural uses for future generations	○	○	○	○	○

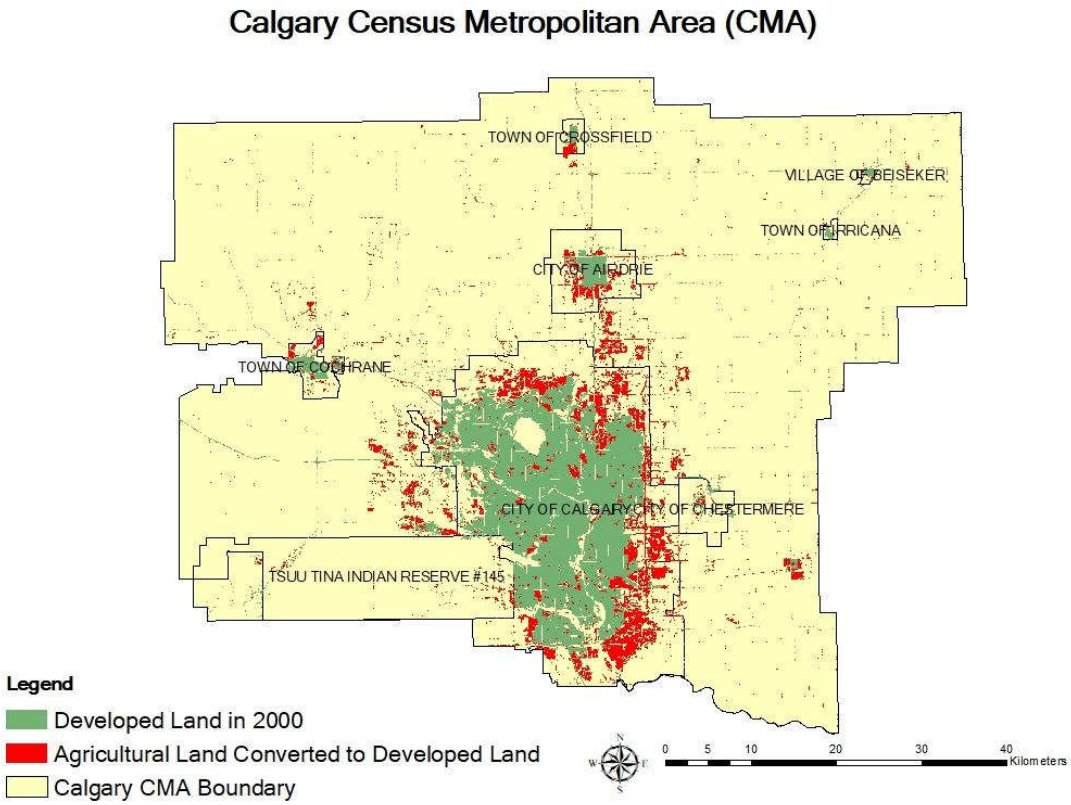
	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
The economic benefits from land in agricultural uses outweigh the benefits that urban land uses provide	○	○	○	○	○
It is desirable to live near land in agricultural uses	○	○	○	○	○

Section B The next set of questions focuses on development planning and conservation of agricultural and natural systems

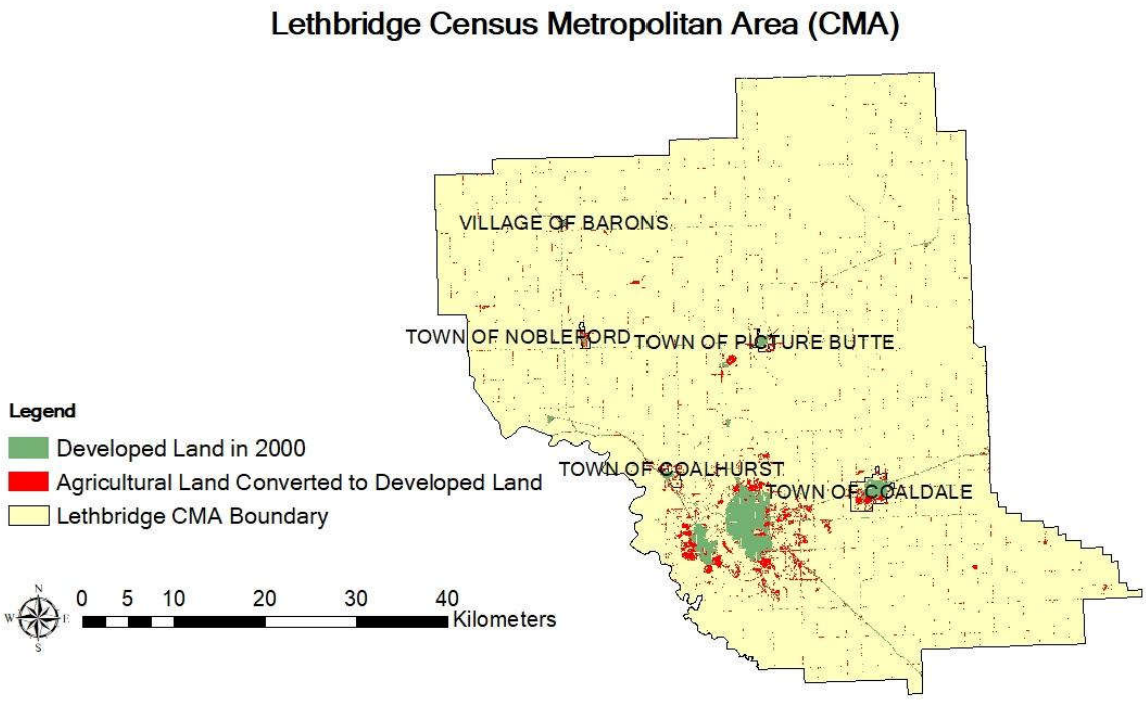
Development planning is concerned with the balance between expansionary development that entails conversion of land from agriculture into urban uses or denser development of land already in urban uses. Next, we provide some information about the **development trend** of agricultural land **from 2000 to 2016** in your area.



This figure displays the **development trend** of agricultural land in the Edmonton Census metropolitan area from 2000 to 2016. The green shaded areas were developed as of 2000; the red shaded areas were converted from agriculture to developed uses between 2000 and 2016. Developed land increased by 128,710 acres, a 75.5% increase. Approximately 92% of the newly developed land was converted from agriculture. This represented a 7.2% reduction in agricultural land.

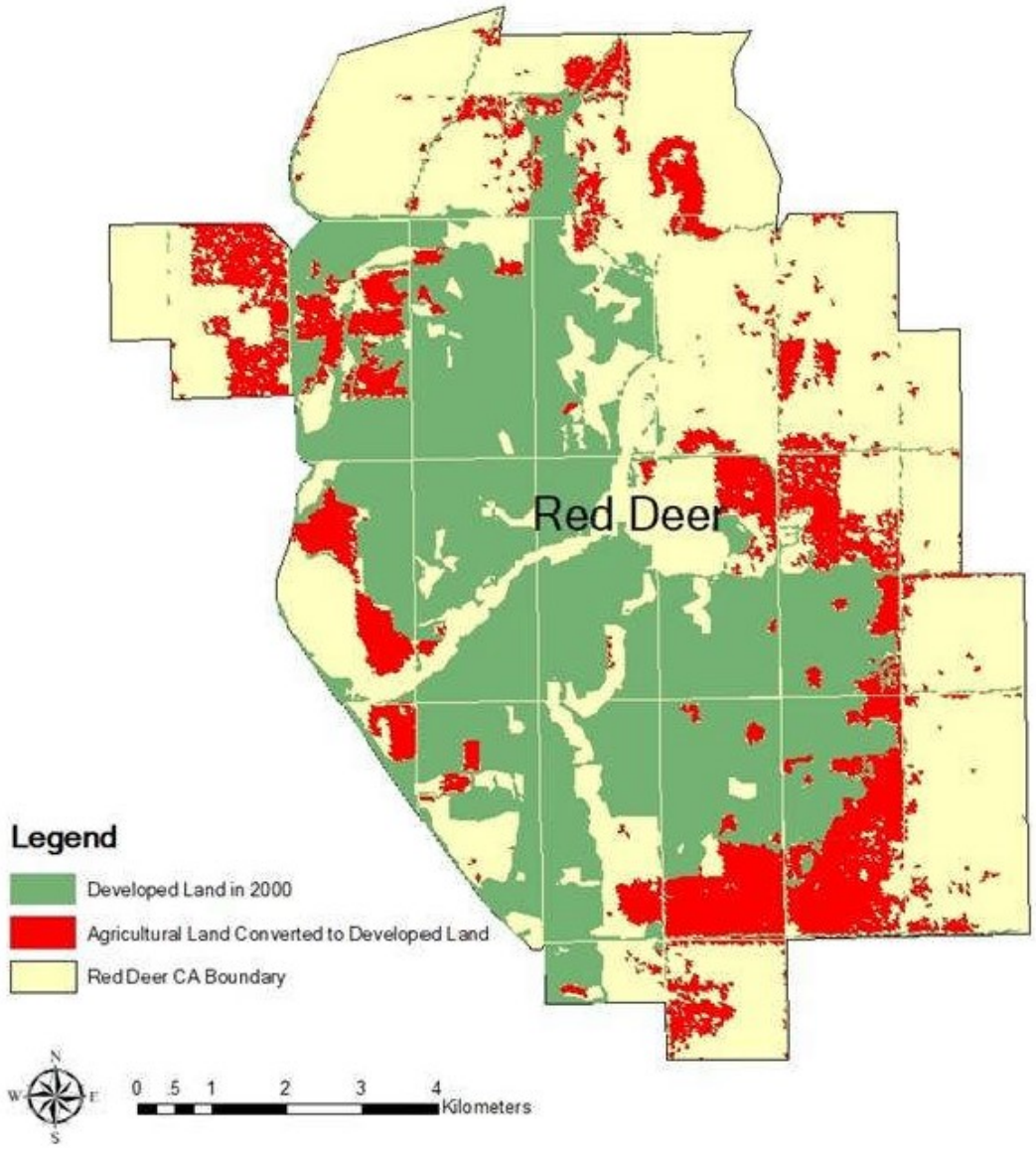


This figure displays the **development trend** of agricultural land in the Calgary Census metropolitan area from 2000 to 2016. The green shaded areas were developed as of 2000; the red shaded areas were converted from agriculture to developed uses between 2000 and 2016. Developed land increased by 72,462 acres, a 63% increase. Approximately 71% of the newly developed land was converted from agriculture. This represented a 6.6% reduction in agricultural land.

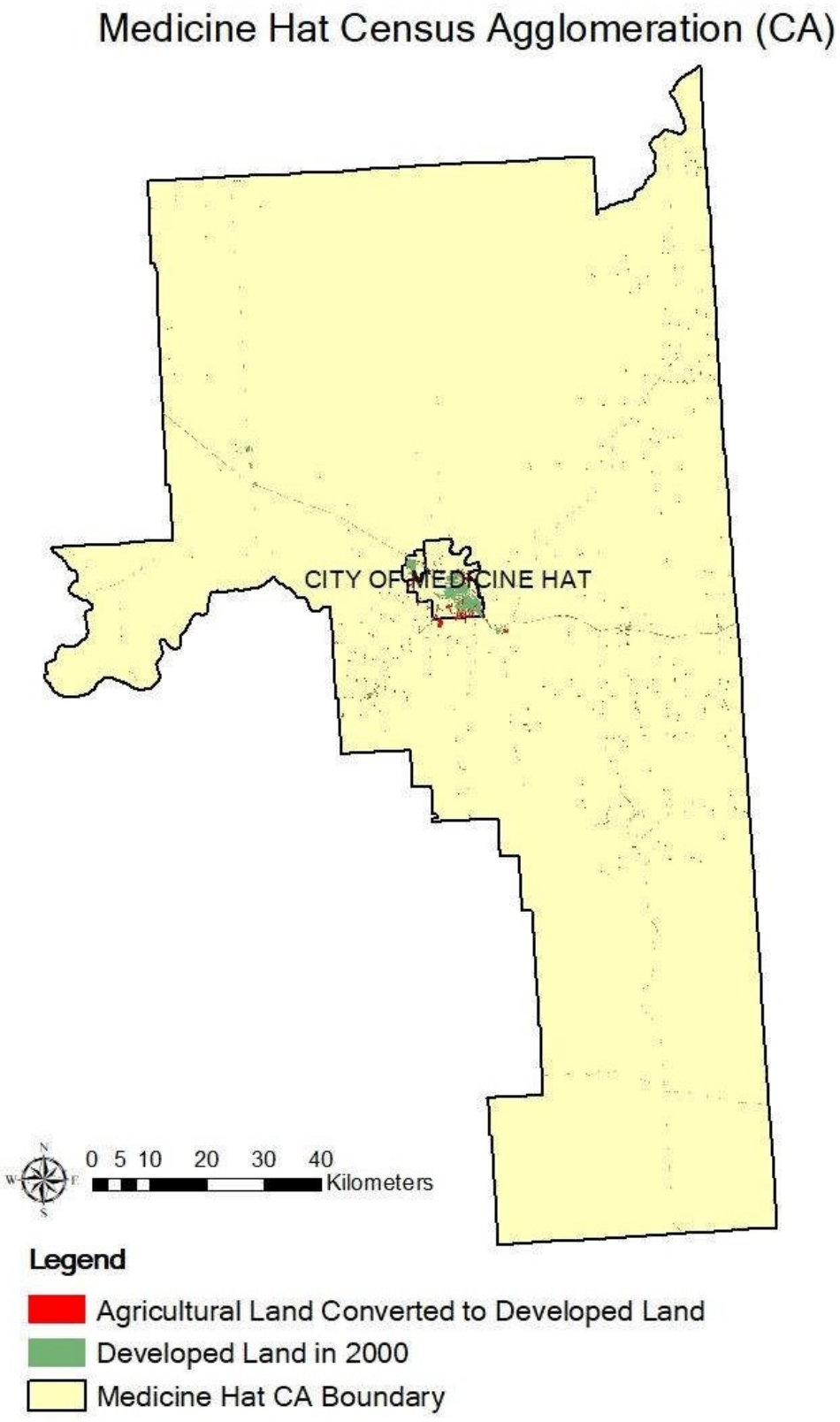


This figure displays the **development trend** of agricultural land in the Lethbridge Census metropolitan area from 2000 to 2016. The green shaded areas were developed as of 2000; the red shaded areas were converted from agriculture to developed uses between 2000 and 2016. Developed land increased by 16,579 acres, a 113% increase. Approximately 93% of the newly developed land was converted from agriculture. This represented a 2.5% reduction in agricultural land.

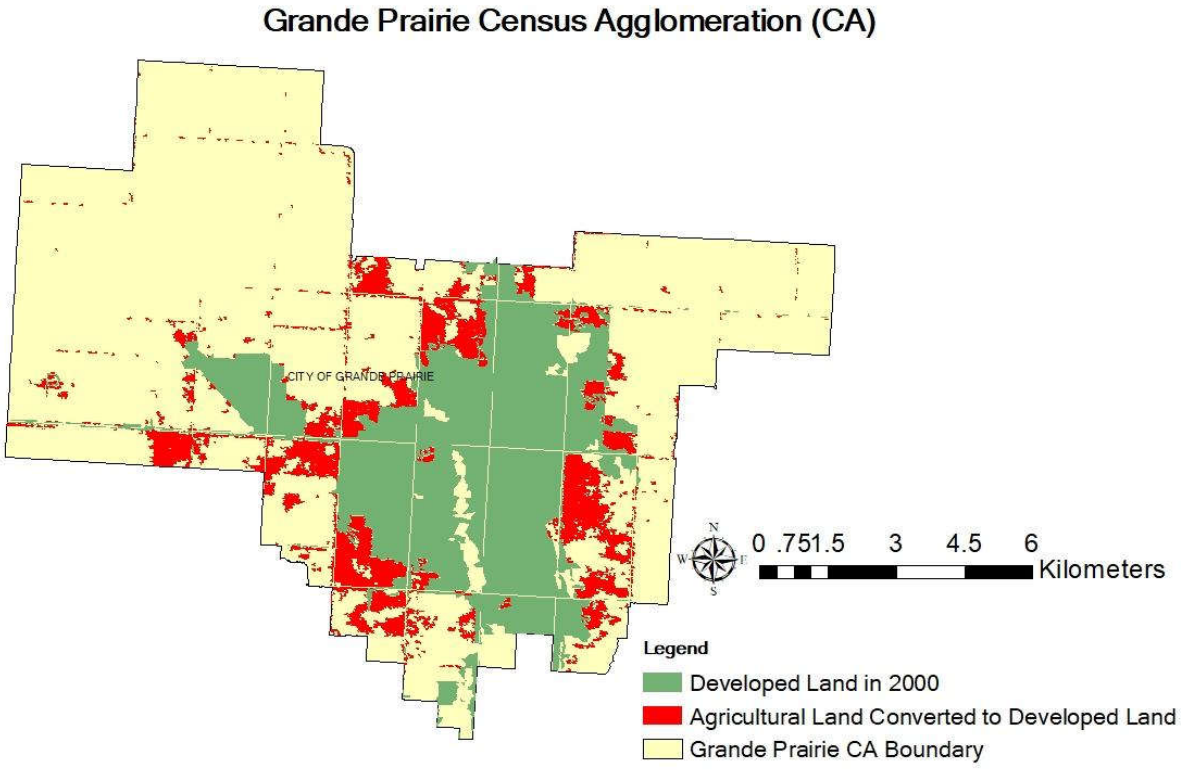
Red Deer Census Agglomeration (CA)



This figure displays the **development trend** of agricultural land in the Red Deer Census Agglomeration area from 2000 to 2016. The green shaded areas were developed as of 2000; the red shaded areas were converted from agriculture to developed uses between 2000 and 2016. Developed land increased by 5,309 acres, a 55% increase. Approximately 75% of the newly developed land was converted from agriculture. This represented a 35% reduction in agricultural land.


Medicine Hat Census Agglomeration (CA)
CITY OF MEDICINE HAT
0 5 10 20 30 40
Kilometers
Legend
Agricultural Land Converted to Developed Land
Developed Land in 2000
Medicine Hat CA Boundary

This figure displays the **development trend** of agricultural land in the Medicine Hat Census Agglomeration area from 2000 to 2016. The green shaded areas were developed as of 2000; the red shaded areas were converted from agriculture to developed uses between 2000 and 2016. Developed land increased by 15,238 acres, a 102.1% increase. Approximately 46% of the newly developed land was converted from agriculture. This represented a 0.87% reduction in agricultural land.



This figure displays the **development trend** of agricultural land in the Grande Prairie census agglomeration area from 2000 to 2016. The green shaded areas

were developed as of 2000; the red shaded areas were converted from agriculture to developed uses between 2000 and 2016. Developed land increased by 3,607 acres, a 45.9% increase. Approximately 94.5% of the newly developed land was converted from agriculture. This represented a 16.1 % reduction in agricultural land.

Question 2

Do you think there now is enough of the following land uses in the census metropolitan area (CMA) or a census agglomeration (CA) where you reside?

	Not Enough	Enough	Too Much	Unsure
Land reserved for agricultural uses	○	○	○	○
Land set aside for urban growth	○	○	○	○
Natural areas	○	○	○	○

Section C The next question focuses on public finances and conserving specific areas of land in agriculture

Planners emphasize that decisions about development and conservation have implications for public finances. Relative to the current development trend, conserving additional areas of land for agriculture could result in additional public costs. This could require additional taxes for current residents. On the

other hand, the same amount of conservation could be achieved by increasing the density of development within existing developed areas.

Question 3

Compared to the development trend that occurred between 2000 and 2016, what type of future urban development do you most favor for the census metropolitan area (CMA) or census agglomeration (CA) where you live.

- ○ Continue current trend observed from 2000-2016
- ○ Denser development that reduces pressure to convert surrounding farmland
- ○ More expansionary development that increases pressure to convert surrounding farmland

Please select 'agree' for this line. Thank you for reading carefully.

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
○	○	○	○	○

Section D The following questions will ask you to compare different strategies for additional farmland conservation with the current development trend in your area

Provincial and municipal governments make many decisions that affect land use. According to provincial policies, governments are expected to develop and follow land use plans that maintain the viability of agricultural operations.

All municipalities and regions in Alberta are required to get input from local

residents as they develop those plans. Some jurisdictions use surveys like this to get such input. We will share our results with the provincial government and municipal governments in the areas covered by this study.

We are asking you to consider 8 proposed conservation strategies. For each strategy, please state whether or not you feel that the proposed strategy, with the associated one-time additional cost to each current taxpayer in your area, should be implemented.

All the proposed strategies would result in the conservation of an additional 1000 acres of farmland somewhere within 10 kilometers of currently developed areas in your area.

These strategies will differ in terms of the following attributes and levels:

Attribute	Level	Explanation
Type of Current Agricultural Use	• Grain or Oilseed Farming • Livestock grazing on native pasture • Commercial Vegetable Farm	Major types of agriculture in your area
Type of urban development without conservation	• Residential • Light Industrial • Retail	Major types of urban development without conservation in your area
One-time additional cost to each taxpayer ($)	• $50 • $100 • $300 • $600 • $1000	One-time additional increase in property tax or rent to each taxpayer in your area

PLEASE NOTE:

We know that a person's choice in a survey may not be a reliable reflection of how that person would behave in an actual vote.

It is very important that you choose as if this was a real vote. You need to imagine that you actually have to dig into your budget and pay the additional one-time increase in tax or rent costs associated with each of the proposed strategies. Remember, the results of this study will be shared with local municipalities. They may decide to change policy as a result.

Please consider the following strategies. In each set presented below, imagine that these are the only options available. For each set, please choose **independently** from other questions - please do not compare options from different sets.

For example, the additional conservation strategy below depicts conservation of land currently used for grain or oilseed farming that could be converted into residential purposes. To prevent that conversion, there would be a **one-time additional increase** of $50 in property tax or rent for each taxpayer in your region. No additional conservation strategy represents the current development trend in your area.

No additional conservation strategy
2000-2016 development trend continues

Additional Conservation Strategy		
Type of Current Agricultural Use	Type of urban development without conservation	One-time additional increase in property tax or rent to each taxpayer in your area ($)
Grain or Oilseed Farming 	Residential 	$50

Block 1

Consider an **additional conservation strategy** that would require that 1000 acres of farmland now used for livestock grazing on native pasture could only be used for livestock grazing on native pasture, compared to a replacement urban development of retail stores. The additional conservation strategy would result in a one-time additional increase in property tax or rent of $600 to each taxpayer in your area.

No additional conservation strategy
2000-2016 development trend continues

Additional Conservation Strategy		
Type of Current Agricultural Use	Type of urban development without conservation	One-time additional increase in property tax or rent to each taxpayer in your area ($)
Livestock Grazing on Native Pasture 	Retail 	$600

Suppose you have to vote between the proposed **Additional Conservation Strategy** and **No Additional Conservation Strategy**. Which one would you vote for?

- ○ No Additional Conservation Strategy
- ○ Additional Conservation Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain

- ○ Neither Certain nor Uncertain
- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Conservation Strategy**, please indicate which aspect is most important to you with respect to the agricultural use conserved.

- ○ Food for national/global market
- ○ Scenic beauty
- ○ Recreation
- ○ Water or air quality
- ○ Food for local market

Block 2

Consider an **additional conservation strategy** that would require that 1000 acres of farmland now used for grain or oilseed farming could only be used for grain or oilseed farming, compared to a replacement urban development of residential. The additional conservation strategy would result in a one-time additional increase in property tax or rent of $1000 to each taxpayer in your area.

No additional conservation strategy
2000-2016 development trend continues

Additional Conservation Strategy		
Type of Current Agricultural Use	Type of urban development without conservation	One-time additional increase in property tax or rent to each taxpayer in your area ($)
Grain or Oilseed Farming 	Residential 	$1000

Suppose you have to vote between the proposed **Additional Conservation Strategy** and **No Additional Conservation Strategy**. Which one would you vote for?

- ○ Additional Conservation Strategy
- ○ No Additional Conservation Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain

- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Conservation Strategy**, please indicate which aspect is most important to you with respect to the agricultural use conserved.

- ○ Food for national/global market
- ○ Food for local market
- ○ Recreation
- ○ Scenic beauty
- ○ Water or air quality

Block 3

Consider an **additional conservation strategy** that would require that 1000 acres of farmland now used for livestock grazing on native pasture could only be used for livestock grazing on native pasture, compared to a replacement urban development of residential. The additional conservation strategy would result in a one-time additional increase in property tax or rent of $50 to each taxpayer in your area.

No additional conservation strategy
2000-2016 development trend continues

Additional Conservation Strategy		
Type of Current Agricultural Use	Type of urban development without conservation	One-time additional increase in property tax or rent to each taxpayer in your area ($)
Livestock Grazing on Native Pasture 	Residential 	$50

Suppose you have to vote between the proposed **Additional Conservation Strategy** and **No Additional Conservation Strategy**. Which one would you vote for?

- ○ No Additional Conservation Strategy
- ○ Additional Conservation Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain

- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Conservation Strategy**, please indicate which aspect is most important to you with respect to the agricultural use conserved.

- ○ Food for local market
- ○ Water or air quality
- ○ Recreation
- ○ Food for national/global market
- ○ Scenic beauty

Block 4

Consider an **additional conservation strategy** that would require that 1000 acres of farmland now used for grain or oilseed farming could only be used for grain or oilseed farming, compared to a replacement urban development of retail stores. The additional conservation strategy would result in a one-time additional increase in property tax or rent of $300 to each taxpayer in your area.

No additional conservation strategy
2000-2016 development trend continues

Additional Conservation Strategy		
Type of Current Agricultural Use	Type of urban development without conservation	One-time additional increase in property tax or rent to each taxpayer in your area ($)
Grain or Oilseed Farming 	Retail 	$300

Suppose you have to vote between the proposed **Additional Conservation Strategy** and **No Additional Conservation Strategy**. Which one would you vote for?

- ○ Additional Conservation Strategy
- ○ No Additional Conservation Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain
- ○ Somewhat Uncertain

- ○ Very Uncertain

If you voted for the proposed **Additional Conservation Strategy**, please indicate which aspect is most important to you with respect to the agricultural use conserved.

- ○ Recreation
- ○ Scenic beauty
- ○ Food for national/global market
- ○ Water or air quality
- ○ Food for local market

Block 5

Consider an **additional conservation strategy** that would require that 1000 acres of farmland now used for grain or oilseed farming could only be used for grain or oilseed farming, compared to a replacement urban development of residential. The additional conservation strategy would result in a one-time additional increase in property tax or rent of $50 to each taxpayer in your area.

No additional conservation strategy
2000-2016 development trend continues

Additional Conservation Strategy		
Type of Current Agricultural Use	Type of urban development without conservation	One-time additional increase in property tax or rent to each taxpayer in your area ($)
Grain or Oilseed Farming 	Residential 	$50

Suppose you have to vote between the proposed **Additional Conservation Strategy** and **No Additional Conservation Strategy**. Which one would you vote for?

- ○ Additional Conservation Strategy
- ○ No Additional Conservation Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain
- ○ Somewhat Uncertain

- ○ Very Uncertain

If you voted for the proposed **Additional Conservation Strategy**, please indicate which aspect is most important to you with respect to the agricultural use conserved.

- ○ Water or air quality
- ○ Scenic beauty
- ○ Food for local market
- ○ Food for national/global market
- ○ Recreation

Block 6

Consider an **additional conservation strategy** that would require that 1000 acres of farmland now used for commercial vegetable farm could only be used for commercial vegetable farm, compared to a replacement urban development of retail stores. The additional conservation strategy would result in a one-time additional increase in property tax or rent of $300 to each taxpayer in your area.

No additional conservation strategy
2000-2016 development trend continues

Additional Conservation Strategy		
Type of Current Agricultural Use	Type of urban development without conservation	One-time additional increase in property tax or rent to each taxpayer in your area ($)
Commercial Vegetable Farm 	Retail 	$300

Suppose you have to vote between the proposed **Additional Conservation Strategy** and **No Additional Conservation Strategy**. Which one would you vote for?

- ○ Additional Conservation Strategy
- ○ No Additional Conservation Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain

- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Conservation Strategy**, please indicate which aspect is most important to you with respect to the agricultural use conserved.

- ○ Recreation
- ○ Scenic beauty
- ○ Food for national/global market
- ○ Water or air quality
- ○ Food for local market

Block 7

Consider an **additional conservation strategy** that would require that 1000 acres of farmland now used for commercial vegetable farm could only be used for commercial vegetable farm, compared to a replacement urban development of residential. The additional conservation strategy would result in a one-time additional increase in property tax or rent of $300 to each taxpayer in your area.

No additional conservation strategy
2000-2016 development trend continues

Additional Conservation Strategy		
Type of Current Agricultural Use	Type of urban development without conservation	One-time additional increase in property tax or rent to each taxpayer in your area ($)
Commercial Vegetable Farm 	Residential 	$300

Suppose you have to vote between the proposed **Additional Conservation Strategy** and **No Additional Conservation Strategy**. Which one would you vote for?

- ○ Additional Conservation Strategy
- ○ No Additional Conservation Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain

- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Conservation Strategy**, please indicate which aspect is most important to you with respect to the agricultural use conserved.

- ○ Water or air quality
- ○ Food for national/global market
- ○ Scenic beauty
- ○ Recreation
- ○ Food for local market

Block 8

Consider an **additional conservation strategy** that would require that 1000 acres of farmland now used for livestock grazing on native pasture could only be used for livestock grazing on native pasture, compared to a replacement urban development of light industrial. The additional conservation strategy would result in a one-time additional increase in property tax or rent of $600 to each taxpayer in your area.

No additional conservation strategy
2000-2016 development trend continues

Additional Conservation Strategy		
Type of Current Agricultural Use	Type of urban development without conservation	One-time additional increase in property tax or rent to each taxpayer in your area ($)
Livestock Grazing on Native Pasture 	Light Industrial 	$600

Suppose you have to vote between the proposed **Additional Conservation Strategy** and **No Additional Conservation Strategy**. Which one would you vote for?

- ○ Additional Conservation Strategy
- ○ No Additional Conservation Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain
- ○ Somewhat Uncertain

- ○ Very Uncertain

If you voted for the proposed **Additional Conservation Strategy**, please indicate which aspect is most important to you with respect to the agricultural use conserved.

- ○ Scenic beauty
- ○ Food for national/global market
- ○ Food for local market
- ○ Water or air quality
- ○ Recreation

Block 9

Consider an **additional conservation strategy** that would require that 1000 acres of farmland now used for grain or oilseed farming could only be used for grain or oilseed farming, compared to a replacement urban development of light industrial. The additional conservation strategy would result in a one-time additional increase in property tax or rent of $100 to each taxpayer in your area.

No additional conservation strategy
2000-2016 development trend continues

Additional Conservation Strategy		
Type of Current Agricultural Use	Type of urban development without conservation	One-time additional increase in property tax or rent to each taxpayer in your area ($)
Grain or Oilseed Farming 	Light Industrial 	$100

Suppose you have to vote between the proposed **Additional Conservation Strategy** and **No Additional Conservation Strategy**. Which one would you vote for?

- ○ Additional Conservation Strategy
- ○ No Additional Conservation Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain

- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Conservation Strategy**, please indicate which aspect is most important to you with respect to the agricultural use conserved.

- ○ Scenic beauty
- ○ Water or air quality
- ○ Recreation
- ○ Food for local market
- ○ Food for national/global market

Block 10

Consider an **additional conservation strategy** that would require that 1000 acres of farmland now used for livestock grazing on native pasture could only be used for livestock grazing on native pasture, compared to a replacement urban development of retail stores. The additional conservation strategy would result in a one-time additional increase in property tax or rent of $50 to each taxpayer in your area.

No additional conservation strategy
2000-2016 development trend continues

Additional Conservation Strategy		
Type of Current Agricultural Use	Type of urban development without conservation	One-time additional increase in property tax or rent to each taxpayer in your area ($)
Livestock Grazing on Native Pasture 	Retail 	$50

Suppose you have to vote between the proposed **Additional Conservation Strategy** and **No Additional Conservation Strategy**. Which one would you vote for?

- ○ Additional Conservation Strategy
- ○ No Additional Conservation Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain

- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Conservation Strategy**, please indicate which aspect is most important to you with respect to the agricultural use conserved.

- ○ Recreation
- ○ Scenic beauty
- ○ Food for local market
- ○ Water or air quality
- ○ Food for national/global market

Block 11

Consider an **additional conservation strategy** that would require that 1000 acres of farmland now used for commercial vegetable farm could only be used for commercial vegetable farm, compared to a replacement urban development of light industrial. The additional conservation strategy would result in a one-time additional increase in property tax or rent of $600 to each taxpayer in your area.

No additional conservation strategy
2000-2016 development trend continues

Additional Conservation Strategy		
Type of Current Agricultural Use	Type of urban development without conservation	One-time additional increase in property tax or rent to each taxpayer in your area ($)
Commercial Vegetable Farm 	Light Industrial 	$600

Suppose you have to vote between the proposed **Additional Conservation Strategy** and **No Additional Conservation Strategy**. Which one would you vote for?

- ○ No Additional Conservation Strategy
- ○ Additional Conservation Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain

- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Conservation Strategy**, please indicate which aspect is most important to you with respect to the agricultural use conserved.

- ○ Water or air quality
- ○ Scenic beauty
- ○ Recreation
- ○ Food for local market
- ○ Food for national/global market

Block 12

Consider an **additional conservation strategy** that would require that 1000 acres of farmland now used for commercial vegetable farm could only be used for commercial vegetable farm, compared to a replacement urban development of residential. The additional conservation strategy would result in a one-time additional increase in property tax or rent of $1000 to each taxpayer in your area.

No additional conservation strategy
2000-2016 development trend continues

Additional Conservation Strategy		
Type of Current Agricultural Use	Type of urban development without conservation	One-time additional increase in property tax or rent to each taxpayer in your area ($)
Commercial Vegetable Farm 	Residential 	$1000

Suppose you have to vote between the proposed **Additional Conservation Strategy** and **No Additional Conservation Strategy.** Which one would you vote for?

- ○ Additional Conservation Strategy
- ○ No Additional Conservation Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain

- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Conservation Strategy**, please indicate which aspect is most important to you with respect to the agricultural use conserved.

- ○ Food for local market
- ○ Food for national/global market
- ○ Scenic beauty
- ○ Recreation
- ○ Water or air quality

Block 13

Consider an **additional conservation strategy** that would require that 1000 acres of farmland now used for grain or oilseed farming could only be used for grain or oilseed farming, compared to a replacement urban development of residential. The additional conservation strategy would result in a one-time additional increase in property tax or rent of $100 to each taxpayer in your area.

No additional conservation strategy
2000-2016 development trend continues

Additional Conservation Strategy		
Type of Current Agricultural Use	Type of urban development without conservation	One-time additional increase in property tax or rent to each taxpayer in your area ($)
Grain or Oilseed Farming 	Residential 	$100

Suppose you have to vote between the proposed **Additional Conservation Strategy** and **No Additional Conservation Strategy**. Which one would you vote for?

- ○ No Additional Conservation Strategy
- ○ Additional Conservation Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain

- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Conservation Strategy**, please indicate which aspect is most important to you with respect to the agricultural use conserved.

- ○ Scenic beauty
- ○ Food for national/global market
- ○ Recreation
- ○ Water or air quality
- ○ Food for local market

Block 14

Consider an **additional conservation strategy** that would require that 1000 acres of farmland now used for livestock grazing on native pasture could only be used for livestock grazing on native pasture, compared to a replacement urban development of light industrial. The additional conservation strategy would result in a one-time additional increase in property tax or rent of $100 to each taxpayer in your area.

No additional conservation strategy
2000-2016 development trend continues

Additional Conservation Strategy		
Type of Current Agricultural Use	Type of urban development without conservation	One-time additional increase in property tax or rent to each taxpayer in your area ($)
Livestock Grazing on Native Pasture 	Light Industrial 	$100

Suppose you have to vote between the proposed **Additional Conservation Strategy** and **No Additional Conservation Strategy**. Which one would you vote for?

- ○ Additional Conservation Strategy
- ○ No Additional Conservation Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain

- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Conservation Strategy**, please indicate which aspect is most important to you with respect to the agricultural use conserved.

- ○ Scenic beauty
- ○ Food for national/global market
- ○ Water or air quality
- ○ Recreation
- ○ Food for local market

Block 15

Consider an **additional conservation strategy** that would require that 1000 acres of farmland now used for grain or oilseed farming could only be used for grain or oilseed farming, compared to a replacement urban development of retail stores. The additional conservation strategy would result in a one-time additional increase in property tax or rent of $1000 to each taxpayer in your area.

No additional conservation strategy
2000-2016 development trend continues

Additional Conservation Strategy		
Type of Current Agricultural Use	Type of urban development without conservation	One-time additional increase in property tax or rent to each taxpayer in your area ($)
Grain or Oilseed Farming 	Retail 	$1000

Suppose you have to vote between the proposed **Additional Conservation Strategy** and **No Additional Conservation Strategy**. Which one would you vote for?

- ○ Additional Conservation Strategy
- ○ No Additional Conservation Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain

- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Conservation Strategy**, please indicate which aspect is most important to you with respect to the agricultural use conserved.

- ○ Food for national/global market
- ○ Scenic beauty
- ○ Recreation
- ○ Food for local market
- ○ Water or air quality

Block 16

Consider an **additional conservation strategy** that would require that 1000 acres of farmland now used for commercial vegetable farm could only be used for commercial vegetable farm, compared to a replacement urban development of light industrial. The additional conservation strategy would result in a one-time additional increase in property tax or rent of $50 to each taxpayer in your area.

No additional conservation strategy
2000-2016 development trend continues

Additional Conservation Strategy		
Type of Current Agricultural Use	Type of urban development without conservation	One-time additional increase in property tax or rent to each taxpayer in your area ($)
Commercial Vegetable Farm 	Light Industrial 	$50

Suppose you have to vote between the proposed **Additional Conservation Strategy** and **No Additional Conservation Strategy**. Which one would you vote for?

- ○ Additional Conservation Strategy
- ○ No Additional Conservation Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain

- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Conservation Strategy**, please indicate which aspect is most important to you with respect to the agricultural use conserved.

- ○ Recreation
- ○ Food for national/global market
- ○ Food for local market
- ○ Water or air quality
- ○ Scenic beauty

follow-up questions

Section E This section asks you some follow-up questions

Question 1

When voting, how important was each of the following attributes to you?

	Not At All Important	Unimportant	Neither Unimportant Nor Important	Important	Very important

	Not At All Important	Unimportant	Neither Unimportant Nor Important	Important	Very important
Type of Current Agricultural Use	○	○	○	○	○
Type of urban development without conservation	○	○	○	○	○
One-time additional increase in property tax or rent to each taxpayer in your area ($)	○	○	○	○	○

Question 2

How likely do you feel the strategies presented in the survey could be really implemented?

- ○ Very Likely
- ○ Somewhat Likely
- ○ Uncertain
- ○ Somewhat Unlikely
- ○ Very Unlikely

Question 3

Do you have any other comments about the content of this survey or the reasons for your answers?

demographics

Section F The next set of questions is about you

Q1: What is your gender?

- ○ Male
- ○ Female
- ○ Other

Q2: What is your age? Please specify the number of years

Q3: Where do you currently reside?

- ○ In a city
- ○ Outside of a city
- ○ [ ] Others, please specify

Q4: What is your postal code? Please specify 6 digits

[ ]

Q5: What is your residential and land ownership status?

	Yes	No
You own your residence	○	○
Your rent your residence	○	○
You own agricultural land	○	○

Q6: Which of the following is the highest level of education you have completed?

(PLEASE CHECK ONE RESPONSE ONLY)

- ○ Lower than high school
- ○ Completed high school

- ○ Completed post-secondary technical school
- ○ Completed university undergraduate degree
- ○ Completed post-graduate degree (e.g., Master or Ph.D.)

Q7: What is your current employment status?

(PLEASE CHECK ONE RESPONSE ONLY)

- ○ Working part-time (self-employed or employed by others)
- ○ Working full-time (self-employed or employed by others)
- ○ Retired
- ○ Student
- ○ Unemployed
- ○ [ ] Other, please specify

Q8: Which listed category best describes your total household income (before tax)?

- ○ Less than $30,000
- ○ $30,000 - $59,999
- ○ $60,000 - $89,999
- ○ $90,000 - $119,999
- ○ $120,000 - $149,999
- ○ Greater than $150,000

Powered by Qualtrics

Default Question Block

Before you proceed with the survey, we need to ensure that you are an eligible respondent. Please answer the following three questions.

Are you 18 years old or older?

- ○ Yes
- ○ No

Are you a homeowner or renter?

- ○ Yes
- ○ No

Where do you currently reside?

- ○ Edmonton region
- ○ Calgary region
- ○ Lethbridge region
- ○ Red Deer region
- ○ Medicine Hat region

- ○ Grande Prairie region
- ○ None of the above

A Survey about

Urban development and conservation of land in Agricultural Uses

in Alberta (Part B)

Alberta Land Institute

PARTICIPANT CONSENT FORM

Title of Study: Urban development and conservation of land in Agricultural Uses (Pro 00085639)

Principal Investigator:

Brent Swallow, Professor
567 General Services Building
University of Alberta
Tel: (780) 492-6656
brent.swallow@ualberta.ca

Why am I being asked to take part in this research study?

A survey company has selected you to participate in this study based on the location of your residence and your willingness to be involved in a survey. You are being asked to participate so that we can gather public opinions about the future of land use in Alberta.

What is the purpose of this study?

The purpose is to understand the views of Alberta residents regarding the conservation and development of land in agricultural uses. We want to identify agricultural uses that are particularly valuable to the public interest and developed uses that are of particular concern. This study is funded by the Alberta Land Institute and the Alberta Real Estate Foundation. The Alberta Land Institute is an independent, non-partisan research institute based at the University of Alberta. The Alberta Real Estate Foundation supports and originates initiatives that enhance the real estate industry and benefit Alberta.

Data and results will be used for academic reports, papers, and graduate theses. Results will also be conveyed to the public and government authorities in Alberta.

What will I be asked to do?

You will be asked questions on various topics regarding land use. The survey should take about 30 minutes.

What are the risks and discomforts?

There are no known risks beyond those you encounter in everyday life.

Will I be paid to be in the research?

There will not be direct payment for your participation. You will be compensated by the survey company once you have completed.

What are the benefits to me?

You will receive no direct benefits from participation in this study, other than the compensation provided by the survey company. Indirect benefits might arise if governments in your region change policies or regulatory practices on the basis of this research.

Do I have to take part in the study?

Participation in this study is by choice. If you decide to not be involved, you can change your mind and stop at any time.

Will my information be kept private?

Your name and contact information will not be collected, and your individual responses will not be shared with anyone. Your comments and ideas will not be

related back to you in any way. Once submitted, data cannot be withdrawn. All data use will comply with the University of Alberta Standards. At the University of Alberta, we keep data stored for 5 years after the end of the study.

What if I have questions?

The plan for this study has been reviewed by a Research Ethics Board at the University of Alberta. If you have questions about your rights or how research should be conducted, you can call (780) 492-2615. Please refer to Research Protocol Number Pro00085639. This office is independent of the researchers.

If you have any questions about the research now or later, please contact the principal investigator: Brent Swallow at (780) 492-6656 or brent.swallow@ualberta.ca.

Consent

If you consent to participate in the experiment, please click on the "Next" symbol to start the survey. Please note that once you advance by clicking "Next" you cannot go back and revise your answers. If you don't consent to participate in the experiment, please click on the "Exit" symbol to finish the survey.

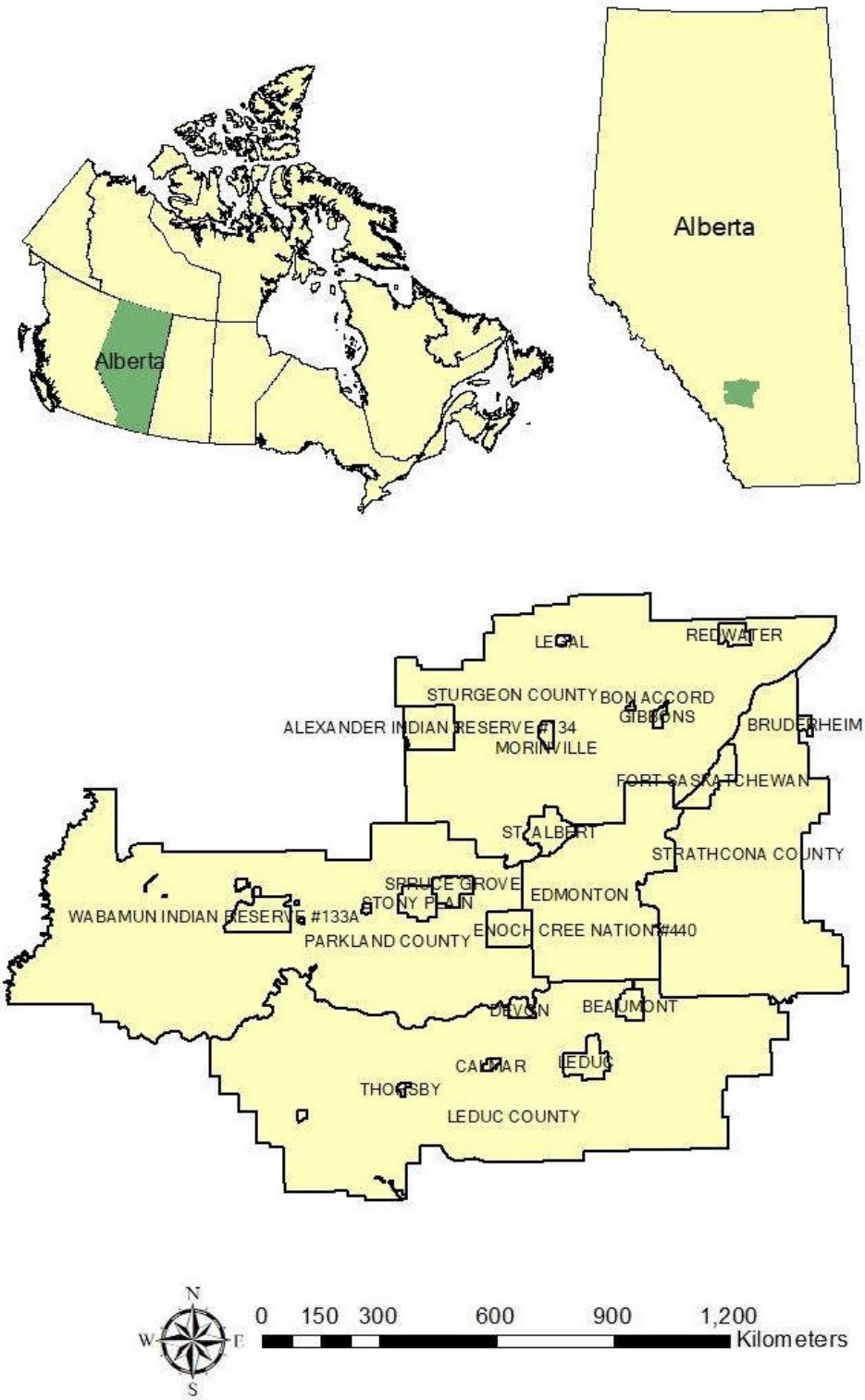
- ○ Next
- ○ Exit

Background

We are directing this survey to residents of the 6 regions listed on the opening

page. The list includes 3 Census Metropolitan Areas (CMAs) and 3 Census Agglomerations (CAs). Both CMAs and CAs comprise one or more adjacent municipalities centered on a core population center. To begin the survey, we provide some background information about your region.

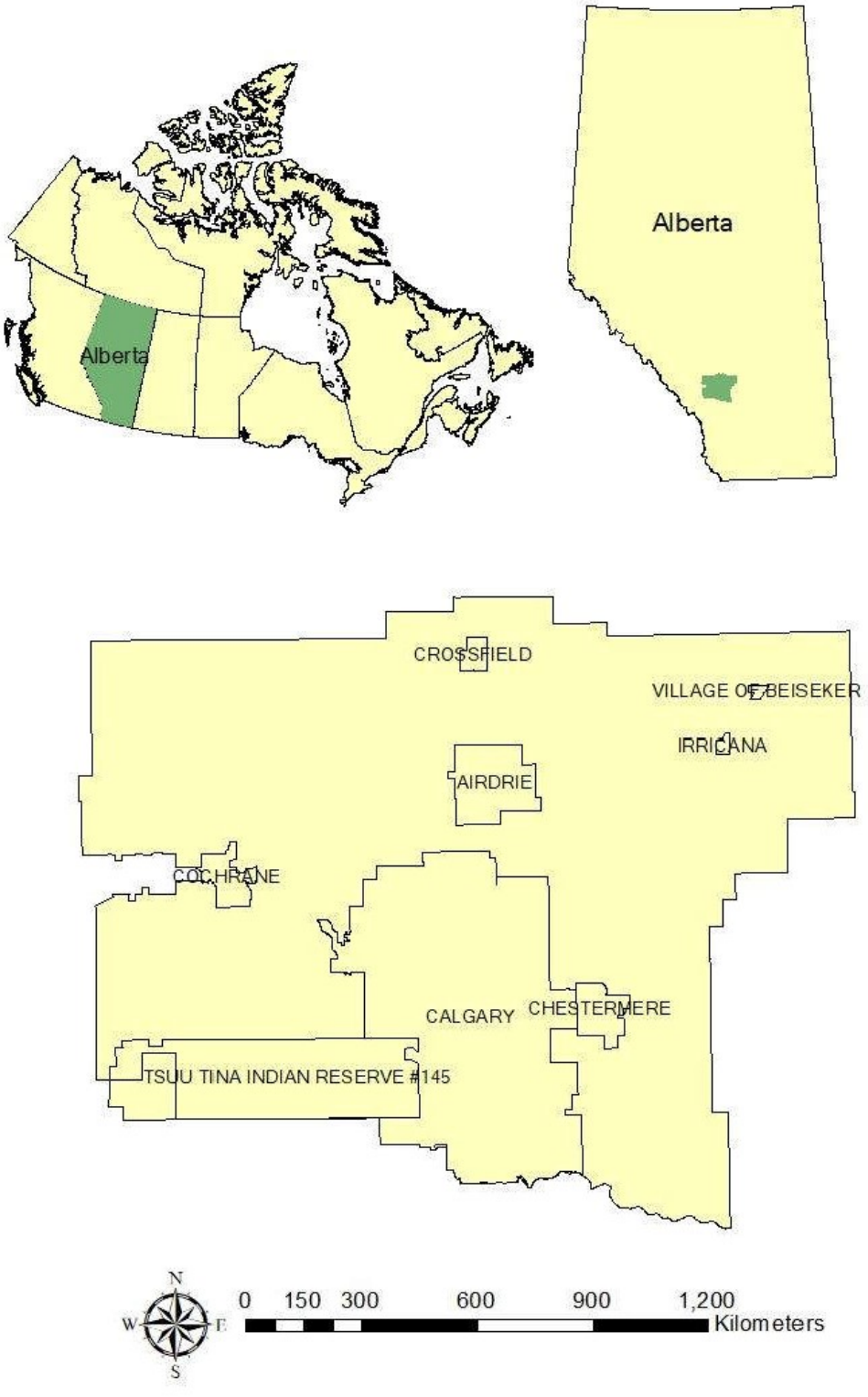
In 2016, the population of the Edmonton census metropolitan area was 1,321,426, which represents an increase of 13.9% from 2011. This compares to the provincial average increase of 11.6% and the national average increase of 5.0%. The Edmonton census metropolitan area (CMA) covers 9,438.86 square kilometers. The population density was 140.0 people per square kilometer in 2016.


Alberta
Alberta
LEGAL
REDWATER
STURGEON COUNTY
BON ACCORD
GIBBONS
ALEXANDER INDIAN RESERVE #134
MORINVILLE
BRUDERHEIM
FORT SASKATCHEWAN
ST. ALBERT
STRATHCONA COUNTY
SPRUCE GROVE
EDMONTON
STONY PLAIN
WABAMUN INDIAN RESERVE #133A
ENOCH CREE NATION #440
PARKLAND COUNTY
DEVON
BEAUMONT
CAMROSE
LEDUC
THORSBY
LEDUC COUNTY
N
W
E
S
0 150 300 600 900 1,200
Kilometers

The Edmonton census metropolitan area (CMA) includes the following 35 census subdivisions (municipalities or municipality equivalents):

- 5 cities: Edmonton, Fort Saskatchewan, Leduc, St. Albert, and Spruce Grove
- 1 specialized municipality: Strathcona County
- 3 municipal districts: Leduc County, Parkland County, and Sturgeon County
- 11 towns: Beaumont, Bon Accord, Bruderheim, Calmar, Devon, Gibbons, Legal, Morinville, Redwater, Thorsby, and Stony Plain
- 3 villages (Spring Lake, Wabamun, and Warburg)
- 8 summer villages: Betula Beach, Golden Days, Itaska Beach, Kapasiwin, Lakeview, Point Alison, Seba Beach, and Sundance Beach
- 4 First Nation Reserves: Alexander 134 of the Alexander First Nation, Stony Plain 135 of the Enoch Cree First Nation, and Wabamun 133A and 133B of the Paul First Nation.

In 2016, the population of Calgary census metropolitan area (CMA) was 1,392,609, which represents an increase of 14.6% from 2011. This compares to the provincial average of 11.6% and the national average increase of 5.0%. The land area of the Calgary census metropolitan area is 5,110.21 square kilometers and the population density was 272.5 people per square kilometer in 2016.


Alberta
Alberta
CROSSFIELD
VILLAGE OF BEISEKER
IRRICANA
AIRDRIE
COCHRANE
CALGARY
CHESTERMERE
TSUU TINA INDIAN RESERVE #145
N
W
E
S
0 150 300 600 900 1,200
Kilometers

The Calgary census metropolitan area, as defined by Statistics Canada, includes the following nine municipalities:

- 3 cities: Airdrie, Calgary, and Chestermere
- 1 municipal district: Rocky View County
- 3 towns: Cochrane, Crossfield, and Irricana
- 1 village: Beiseker
- 1 First Nations reserve: Tsuu T'ina Nation

In 2016, the population of the Lethbridge census metropolitan area (CMA) was 117,394, which represents an increase of 10.8% from 2011. This compares to the provincial average increase of 11.6% and the national average increase of 5.0%.

The land area of the Lethbridge census metropolitan area is 2,975.08 square kilometers and the population density was 39.5 people per square kilometer in 2016.


Alberta
Alberta
BARONS
NOBLEFORD
PICTURE BUTTE
COALHURST
COALDALE
N
W
E
S
0 100 200 400 600 800
Kilometers

The Lethbridge census metropolitan area, as defined by Statistics Canada, includes the following nine municipalities:

- 1 city: Lethbridge
- 1 municipal district: Lethbridge County
- 3 towns: Coaldale, Coalhurst and Picture Butte
- 2 village: Nobleford and Barons

In 2016, the population of the Red Deer census agglomeration (CA) was 100,418, which represents an increase of 10.9% from 2011. This compares to the provincial average increase of 11.6% and the national average increase of 5.0%.
The land area of Red Deer is 104.7 square kilometers and the population density was 958.8 people per square kilometer in 2016.


Alberta
Alberta
Red Deer
N
W
E
S
0 100 200 400 600 800
Kilometers

In 2016, the population of the Medicine Hat census agglomeration (CA) was 76,522, which represents an increase of 5.1% from 2011. This compares to the provincial average increase of 11.6% and the national average increase of 5.0%.

The land area of Medicine Hat is 13,301.54 square kilometers and the population density was 5.8 people per square kilometer in 2016.


Alberta
Alberta
REDCLIFF
MEDICINE HAT
N
W
E
S
0 100 200 400 600 800
Kilometers

The Medicine Hat census agglomeration (CA), as defined by Statistics Canada, includes the following three municipalities:

- 1 city: Medicine Hat
- 1 municipal district: Cypress County
- 1 town: Redcliff

In 2016, the population of the Grande Prairie census agglomeration (CA) was 63,166, which represents an increase of 13.5% from 2011. This compares to the provincial average increase of 11.6% and the national average increase of 5.0%.

The land area of Grande Prairie is 132.73 square kilometers and the population density was 475.9 people per square kilometer in 2016.


Alberta
Alberta
Alberta
CITY OF GRANDE PRAIRIE
N
W
E
S
0 100 200 400 600 800
Kilometers

Section A To begin with the survey, we ask a few questions about agricultural land use

Land can be used for extensive (e.g. field crops, pastures for cow-calf operations) and intensive (e.g. confined feeding operations, greenhouse, market gardens) agriculture. Land can also be converted from agriculture to urban uses (residential, industrial, or retail).

These land uses generate four categories of ecosystem goods and services:

- Provisioning Services, such as food, fresh water, and minerals
- Regulating Services, such as water purification, flood control, and pollination
- Cultural Services, such as aesthetics, recreation, and education
- Supporting Services, such as soil formation and biodiversity conservation

Question 1

1a. Please indicate what you think of the following statements by clicking the button that best describes your level of agreement or disagreement.

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Agree	Strongly agree

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Agree	Strongly agree
The primary function of land in agricultural uses is to produce food	○	○	○	○	○
Land in agricultural uses helps to clean air and water	○	○	○	○	○
Land in agricultural uses conserves the diversity of natural systems	○	○	○	○	○
Land in agricultural uses provides social benefits such as recreational opportunities	○	○	○	○	○

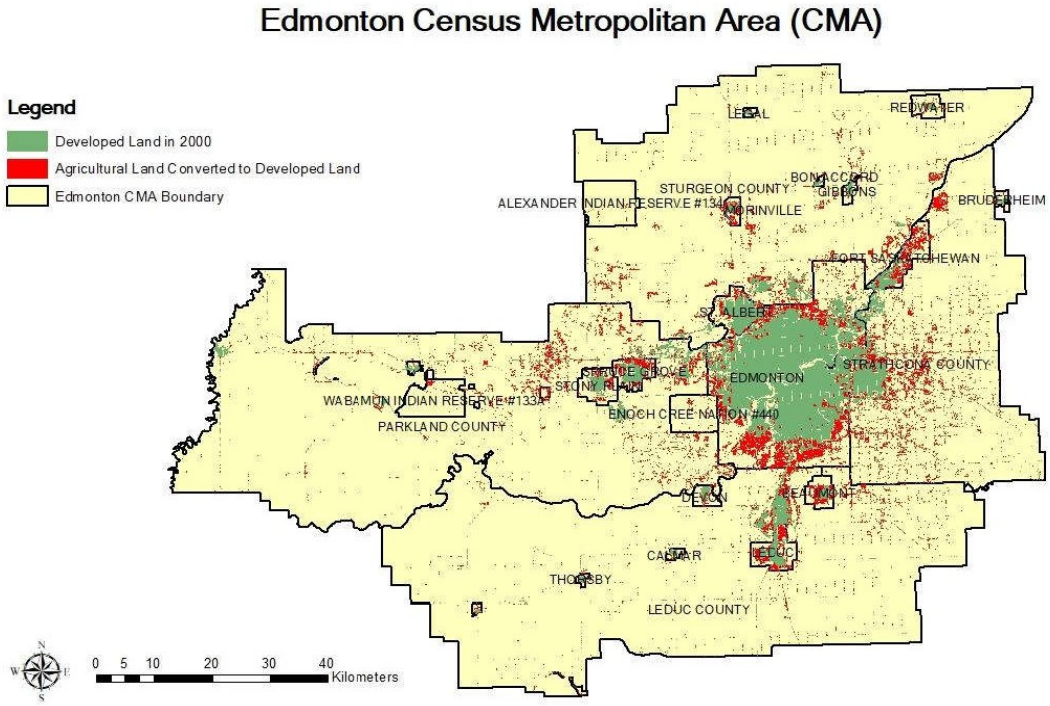
1b. Please indicate what you think of the following statements by clicking the button that best describes your level of agreement or disagreement.

	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree

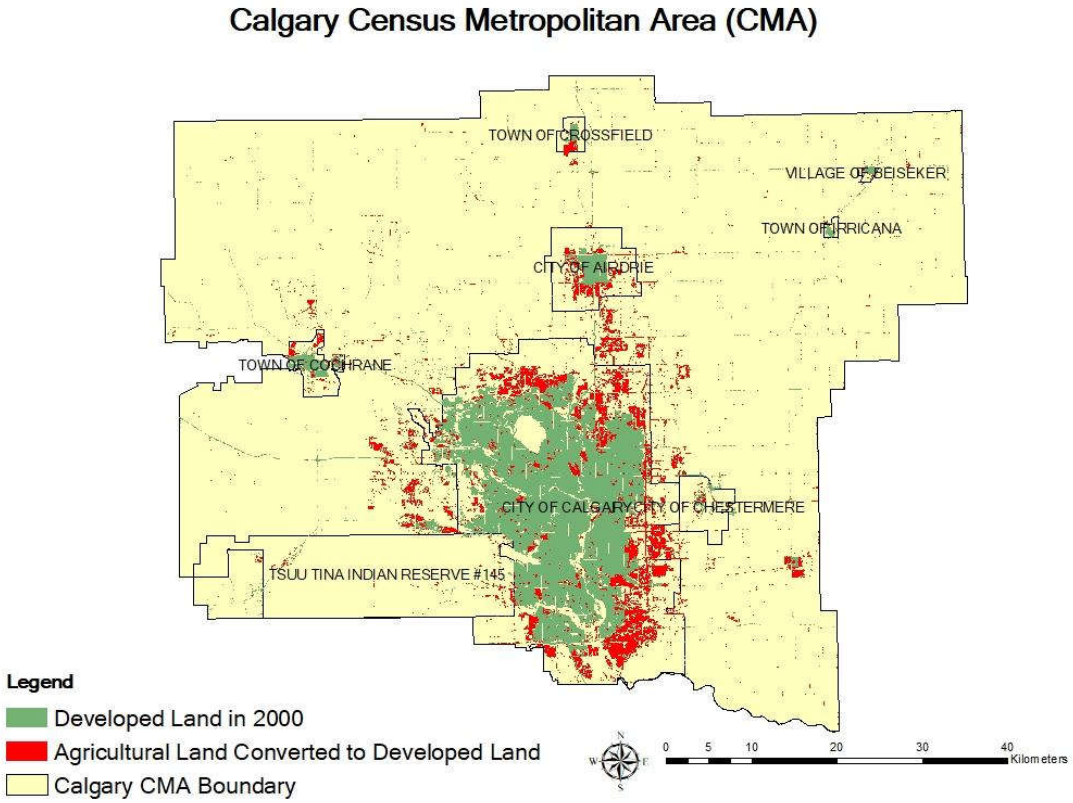
	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
It is important to maintain land in agricultural uses for future generations	○	○	○	○	○
The economic benefits from land in agricultural uses outweigh the benefits that urban land uses provide	○	○	○	○	○
It is desirable to live near land in agricultural uses	○	○	○	○	○

Section B The next set of questions focuses on development planning and conservation of agricultural and natural systems

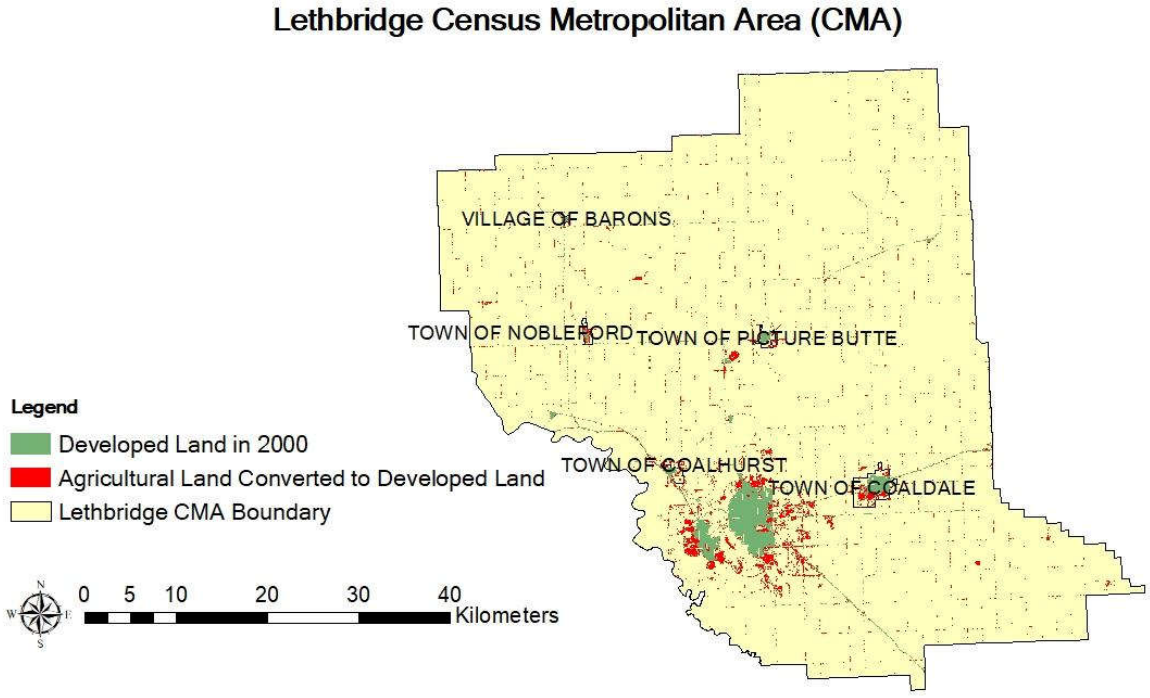
Development planning is concerned with the balance between expansionary development that entails conversion of land from agriculture into urban uses or denser development of land already in urban uses. Next, we provide some information about the **development trend** of conversion of agricultural land **from 2000 to 2016** in your area.



This figure displays the **development trend** of agricultural land in the Edmonton Census metropolitan area from 2000 to 2016. The green shaded areas were developed as of 2000; the red shaded areas were converted from agriculture to developed uses between 2000 and 2016. Developed land increased by 128,710 acres, a 75.5% increase. Approximately 92% of the newly developed land was converted from agriculture. This represented a 7.2% reduction in agricultural land.

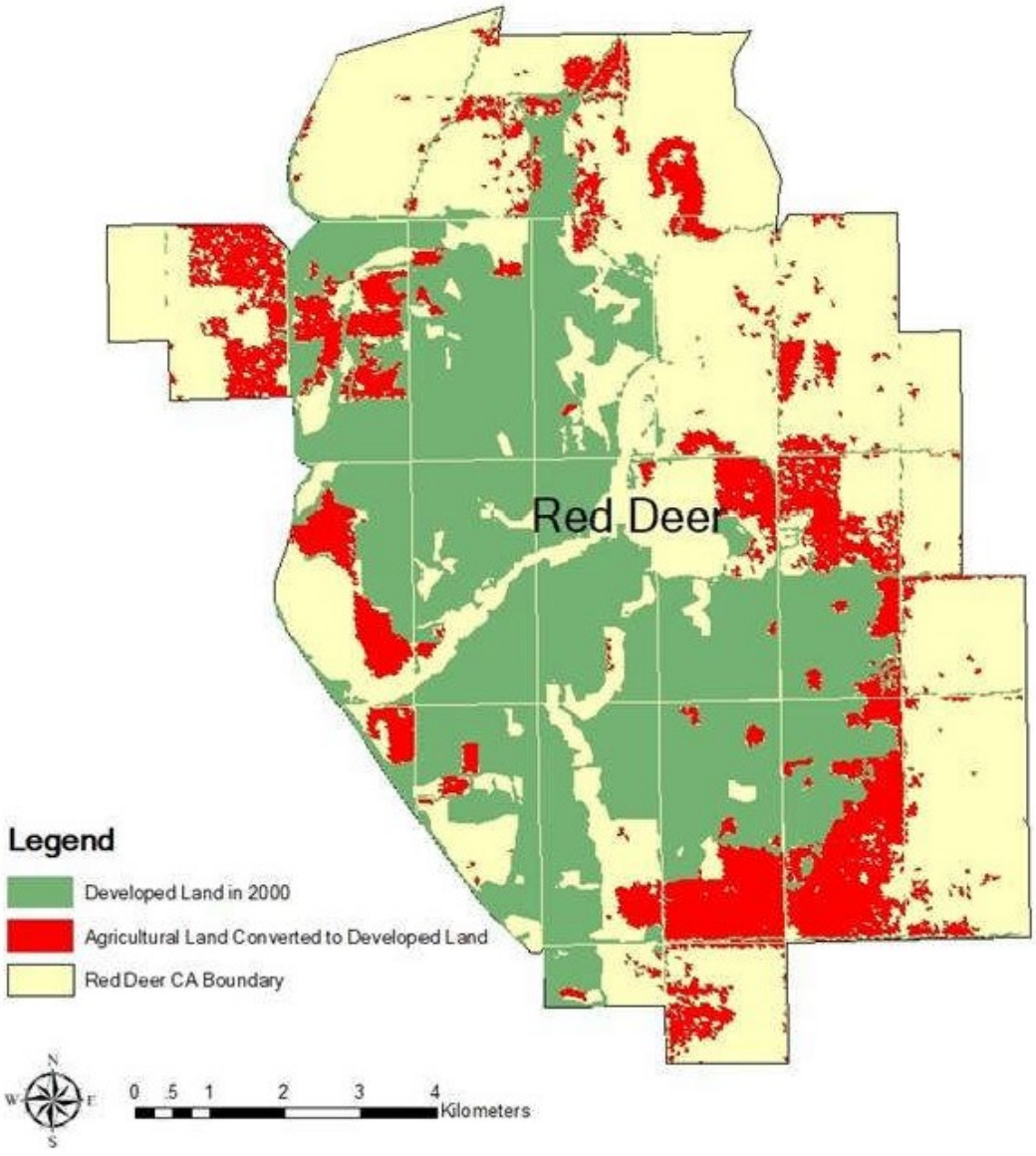


This figure displays the **development trend** of agricultural land in the Calgary Census metropolitan area from 2000 to 2016. The green shaded areas were developed as of 2000; the red shaded areas were converted from agriculture to developed uses between 2000 and 2016. Developed land increased by 72,462 acres, a 63% increase. Approximately 71% of the newly developed land was converted from agriculture. This represented a 6.6% reduction in agricultural land.

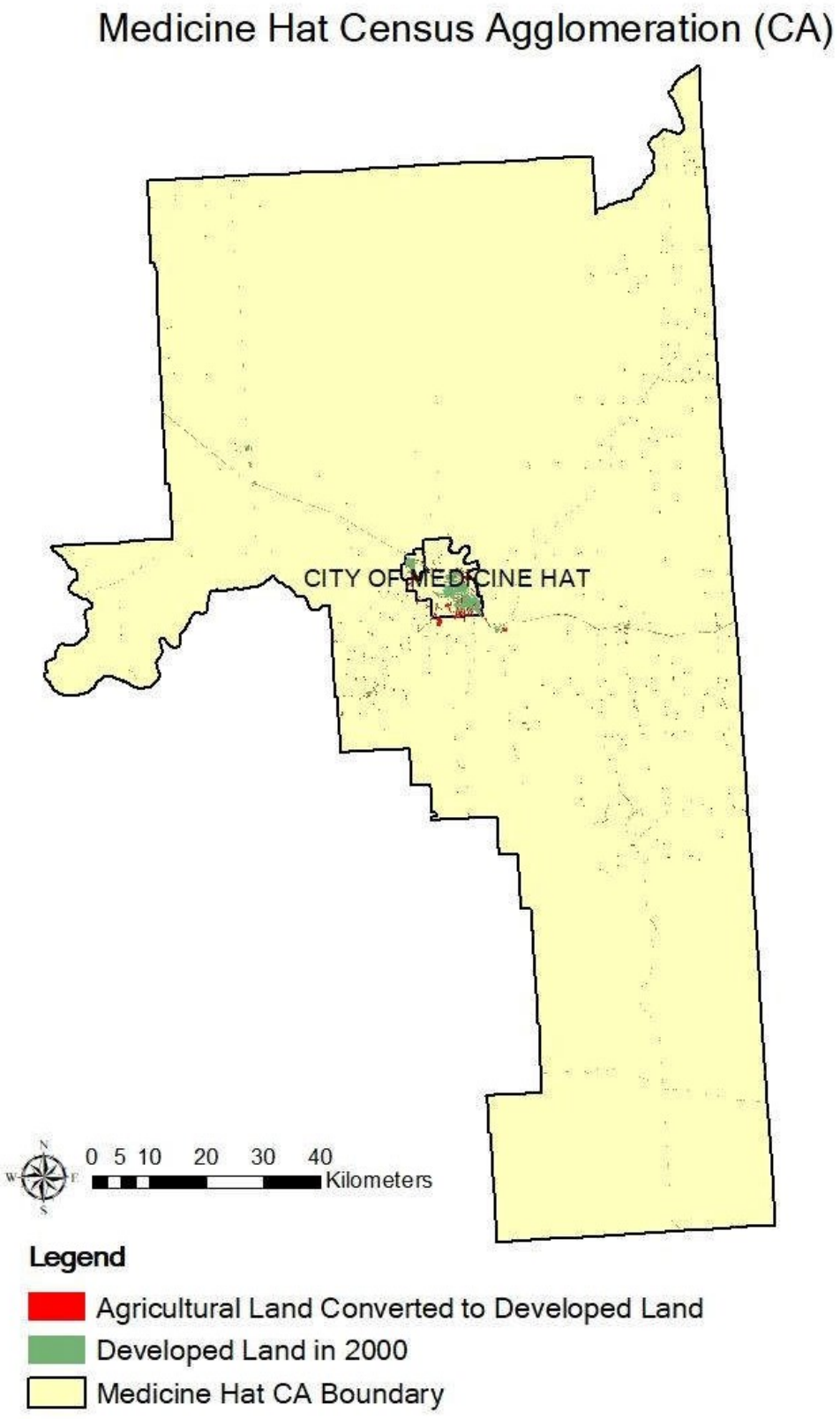


This figure displays the **development trend** of agricultural land in the Lethbridge Census metropolitan area from 2000 to 2016. The green shaded areas were developed as of 2000; the red shaded areas were converted from agriculture to developed uses between 2000 and 2016. Developed land increased by 16,579 acres, a 113% increase. Approximately 93% of the newly developed land was converted from agriculture. This represented a 2.5% reduction in agricultural land.

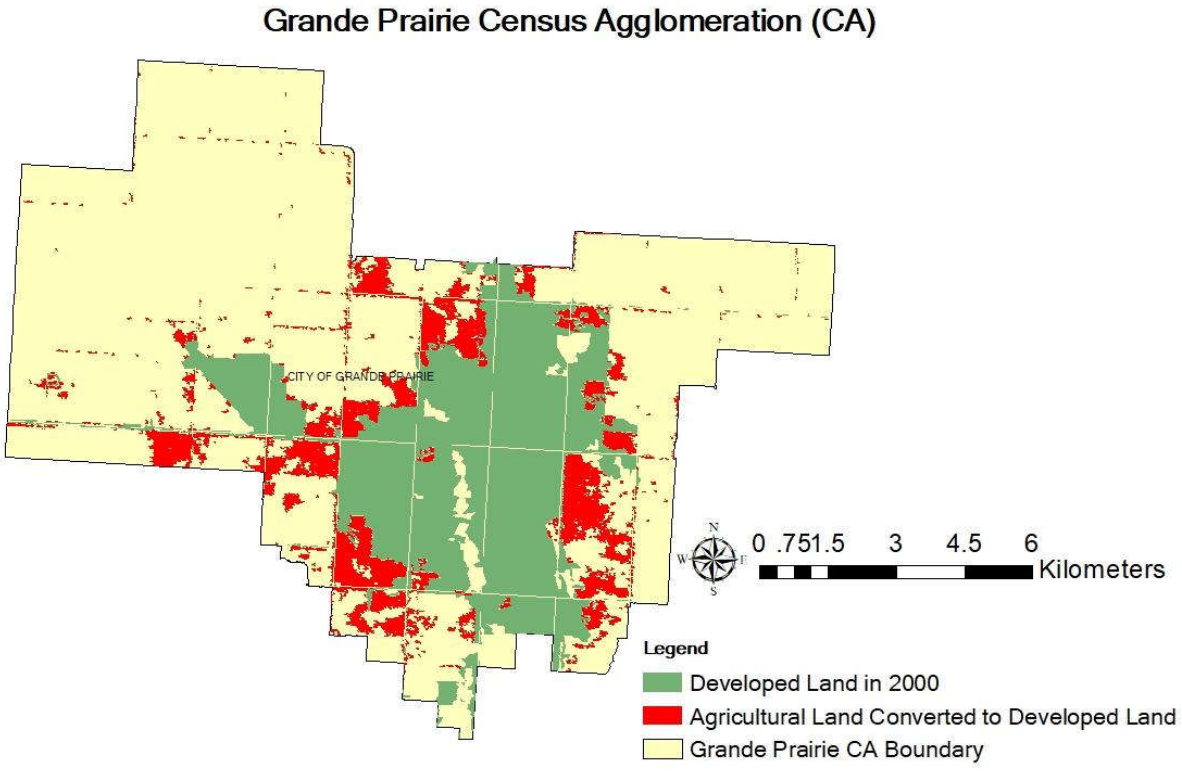
Red Deer Census Agglomeration (CA)



This figure displays the **development trend** of agricultural land in the Red Deer Census Agglomeration area from 2000 to 2016. The green shaded areas were developed as of 2000; the red shaded areas were converted from agriculture to developed uses between 2000 and 2016. Developed land increased by 5,309 acres, a 55% increase. Approximately 75% of the newly developed land was converted from agriculture. This represented a 35% reduction in agricultural land.


Medicine Hat Census Agglomeration (CA)
CITY OF MEDICINE HAT
0 5 10 20 30 40
Kilometers
Legend
Agricultural Land Converted to Developed Land
Developed Land in 2000
Medicine Hat CA Boundary

This figure displays the **development trend** of agricultural land in the Medicine Hat Census Agglomeration area from 2000 to 2016. The green shaded areas were developed as of 2000; the red shaded areas were converted from agriculture to developed uses between 2000 and 2016. Developed land increased by 15,238 acres, a 102.1% increase. Approximately 46% of the newly developed land was converted from agriculture. This represented a 0.87% reduction in agricultural land.



This figure displays the **development trend** of agricultural land in the Grande Prairie census agglomeration area from 2000 to 2016. The green shaded areas

were developed as of 2000; the red shaded areas were converted from agriculture to developed uses between 2000 and 2016. Developed land increased by 3,607 acres, a 45.9% increase. Approximately 94.5% of the newly developed land was converted from agriculture. This represented a 16.1 % reduction in agricultural land.

Question 2

Do you think there now is enough of the following land uses in the census metropolitan area (CMA) or a census agglomeration (CA) where you reside?

	Not Enough	Enough	Too Much	Unsure
Land reserved for agricultural uses	○	○	○	○
Land set aside for urban growth	○	○	○	○
Natural areas	○	○	○	○

Section C The next question focuses on public finances and conserving specific areas of land in agriculture

Planners emphasize that decisions about development and conservation have implications for public finances. Relative to the current development trend, conserving additional areas of land for agriculture could result in additional public costs. This could require additional taxes for current residents. On the

other hand, the same amount of conservation could be achieved by increasing the density of development within existing developed areas.

Question 3

Compared to the development trend that occurred between 2000 and 2016, what type of future urban development do you most favor for the census metropolitan area (CMA) or census agglomeration (CA) where you live.

- ○ Continue current trend observed from 2000-2016
- ○ Denser development that reduces pressure to convert surrounding farmland
- ○ More expansionary development that increases pressure to convert surrounding farmland

Please select 'agree' for this line. Thank you for reading carefully.

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
○	○	○	○	○

Section D The following questions will ask you to compare different strategies for additional urban development with the current development trend in your area

Provincial and municipal governments make many decisions that affect land use and the conversion of land from agricultural to developed uses. These decisions should comply with the Alberta Land Stewardship Act and the Municipal Government Act. According to these acts, governments are expected to conserve land with high environmental value. They should also develop and

follow land use plans that maintain the viability of agricultural operations.

All municipalities and regions in Alberta are required to get input from local residents as they develop those plans. Some areas use surveys like this to get such input. We will share our results with the provincial government and municipal governments in the areas covered by this study.

We are asking you to consider 8 proposed development strategies. For each strategy, please state whether or not you feel that the proposed strategy, with the associated one-time compensation paid to each current taxpayer in your area, should be implemented.

All the proposed strategies would result in the conversion of an additional 1000 acres of farmland somewhere within 10 kilometers of currently developed areas in your area.

These strategies will differ in terms of the following attributes and levels:

Attribute	Level	Explanation
Type of Current Agricultural Use	• Grain or Oilseed Farming • Livestock grazing on native pasture • Commercial Vegetable Farm	Major types of agriculture in your area.
Type of urban development without conservation	• Residential • Light Industrial • Retail	Major types of urban development without conservation in your area
One-time compensation paid to each taxpayer ($)	• $50 • $100 • $300 • $600 • $1000	One-time reduction in property tax or rent to each taxpayer in your area

PLEASE NOTE:

We know that a person's choice in a survey may not be a reliable reflection of how that person would behave in an actual vote.

It is very important that you choose as if this was a real vote. You need to imagine that you would benefit from a one-time reduction in your property taxes or rent costs associated with each of the proposed strategies. You may have had experience with such incentives provided as tax credits. Remember, the results of this study will be shared with local municipalities. They may decide to change policy as a result.

Please consider the following strategies. In each set presented below, imagine that these are the only options available for you to choose from. For each set, please choose **independently** from other questions - please do not compare options from different sets.

For example, this additional development strategy represents that the current agricultural use of this 1000 acre area is grain or oilseed farming. The possible replacement developed land use is residential. To compensate for this change in land use, each taxpayer in your area would receive a **one-time reduction** in property tax or rent of $50. Current development trend represents the current development strategy in your area, which is some blend of denser and more expansionary development.

Current Development Trend
2000-2016 development trend continues

Additional Development Strategy		
Type of Current Agricultural Use	Type of replacement urban development	One-time reduction in property tax or rent to each taxpayer in your area ($)
Grain or Oilseed Farming 	Residential 	$50

Block 1

Consider an **additional development strategy** that would cause the conversion of 1000 acres of farmland from the current agricultural use of grain or oilseed farming to the
replacement type of urban development of light industrial. The additional development strategy would result in a one-time reduction in property tax or rent of $100 to each taxpayer in your area.

Current Development Trend
2000-2016 development trend continues

Additional Development Strategy		
Type of Current Agricultural Use	Type of replacement urban development	One-time reduction in property tax or rent to each taxpayer in your area ($)
Grain or Oilseed Farming 	Light Industrial 	$100

Suppose you have to vote between the proposed **Additional Development Strategy** and **Current Development Trend**. Which one would you vote for?

- ○ Current Development Trend
- ○ Additional Development Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain
- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Development Strategy**, please indicate which aspect you think is most important to you with respect to developed uses.

- ○ Increase local employment
- ○ Increase property tax revenue
- ○ Expansion of public services
- ○ Easier access to consumer goods
- ○ More available housing

Block 2

Consider an **additional development strategy** that would cause the conversion of 1000 acres of farmland from the current agricultural use of livestock grazing on native pasture to the replacement type of urban development of retail. The additional development strategy would result in a one-time reduction in property tax or rent of $50 to each taxpayer in your area.

Current Development Trend
2000-2016 development trend continues

Additional Development Strategy		
Type of Current Agricultural Use	Type of replacement urban development	One-time reduction in property tax or rent to each taxpayer in your area ($)
Livestock Grazing on Native Pasture 	Retail 	$50

Suppose you have to vote between the proposed **Additional Development Strategy** and **Current Development Trend**. Which one would you vote for?

- ○ Current Development Trend
- ○ Additional Development Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain
- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Development Strategy**, please indicate which aspect you think is most important to you with respect to developed uses.

- ○ Increase local employment
- ○ Increase property tax revenue
- ○ Expansion of public services
- ○ Easier access to consumer goods
- ○ More available housing

Block 3

Consider an **additional development strategy** that would cause the conversion of 1000 acres of farmland from the current agricultural use of commercial vegetable farm to the replacement type of urban development of light industrial. The additional development strategy would result in a one-time reduction in property tax or rent of $600 to each taxpayer in your area.

Current Development Trend
2000-2016 development trend continues

Additional Development Strategy		
Type of Current Agricultural Use	Type of replacement urban development	One-time reduction in property tax or rent to each taxpayer in your area ($)
Commercial Vegetable Farm 	Light Industrial 	$600

Suppose you have to vote between the proposed **Additional Development Strategy** and **Current Development Trend**. Which one would you vote for?

- ○ Current Development Trend
- ○ Additional Development Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain
- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Development Strategy**, please indicate which aspect you think is most important to you with respect to developed uses.

- ○ Increase local employment
- ○ Increase property tax revenue
- ○ Expansion of public services
- ○ Easier access to consumer goods
- ○ More available housing

Block 4

Consider an **additional development strategy** that would cause the conversion of 1000 acres of farmland from the current agricultural use of commercial vegetable farm to the replacement type of urban development of

residential. The additional development strategy would result in a one-time reduction in property tax or rent of $1000 to each taxpayer in your area.

Current Development Trend
2000-2016 development trend continues

Additional Development Strategy		
Type of Current Agricultural Use	Type of replacement urban development	One-time reduction in property tax or rent to each taxpayer in your area ($)
Commercial Vegetable Farm 	Residential 	$1000

Suppose you have to vote between the proposed **Additional Development Strategy** and **Current Development Trend**. Which one would you vote for?

- ○ Current Development Trend
- ○ Additional Development Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain
- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Development Strategy**, please indicate which aspect you think is most important to you with respect to developed uses.

- ○ Increase local employment
- ○ Increase property tax revenue
- ○ Expansion of public services
- ○ Easier access to consumer goods
- ○ More available housing

Block 5

Consider an **additional development strategy** that would cause the conversion of 1000 acres of farmland from the current agricultural use of grain or oilseed farming to the replacement type of urban development of residential. The additional development strategy would result in a one-time reduction in property tax or rent of $100 to each taxpayer in your area.

Current Development Trend
2000-2016 development trend continues

Additional Development Strategy		
Type of Current Agricultural Use	Type of replacement urban development	One-time reduction in property tax or rent to each taxpayer in your area ($)
Grain or Oilseed Farming 	Residential 	$100

Suppose you have to vote between the proposed Additional Development Strategy and Current Development Trend. Which one would you vote for?

- ○ Current Development Trend
- ○ Additional Development Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain

- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain
- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Development Strategy**, please indicate which aspect you think is most important to you with respect to developed uses.

- ○ Increase local employment
- ○ Increase property tax revenue
- ○ Expansion of public services
- ○ Easier access to consumer goods
- ○ More available housing

Block 6

Consider an **additional development strategy** that would cause the conversion of 1000 acres of farmland from the current agricultural use of livestock grazing on native pasture to the replacement type of urban development of light industrial. The additional development strategy would result in a one-time reduction in property tax or rent of $100 to each taxpayer in your area.

Current Development Trend
2000-2016 development trend continues

Additional Development Strategy		
Type of Current Agricultural Use	Type of replacement urban development	One-time reduction in property tax or rent to each taxpayer in your area ($)
Livestock Grazing on Native Pasture 	Light Industrial 	$100

Suppose you have to vote between the proposed **Additional Development Strategy** and **Current Development Trend.** Which one would you vote for?

- ○ Current Development Trend
- ○ Additional Development Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain
- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Development Strategy**, please indicate which aspect you think is most important to you with respect to developed uses.

- ○ Increase local employment
- ○ Increase property tax revenue
- ○ Expansion of public services
- ○ Easier access to consumer goods
- ○ More available housing

Block 7

Consider an **additional development strategy** that would cause the conversion of 1000 acres of farmland from the current agricultural use of grain or oilseed farming to the replacement type of urban development of retail. The additional development strategy would result in a one-time reduction in

property tax or rent of $1000 to each taxpayer in your area.

Current Development Trend
2000-2016 development trend continues

Additional Development Strategy		
Type of Current Agricultural Use	Type of replacement urban development	One-time reduction in property tax or rent to each taxpayer in your area ($)
Grain or Oilseed Farming 	Retail 	$1000

Suppose you have to vote between the proposed **Additional Development Strategy** and **Current Development Trend.** Which one would you vote for?

- ○ Current Development Trend
- ○ Additional Development Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain
- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Development Strategy**, please indicate which aspect you think is most important to you with respect to developed uses.

- ○ Increase local employment
- ○ Increase property tax revenue
- ○ Expansion of public services
- ○ Easier access to consumer goods
- ○ More available housing

Block 8

Consider an **additional development strategy** that would cause the conversion of 1000 acres of farmland from the current agricultural use of commercial vegetable farm to the replacement type of urban development of light industrial. The additional development strategy would result in a one-time reduction in property tax or rent of $50 to each taxpayer in your area.

Current Development Trend
2000-2016 development trend continues

Additional Development Strategy		
Type of Current Agricultural Use	Type of replacement urban development	One-time reduction in property tax or rent to each taxpayer in your area ($)
Commercial Vegetable Farm 	Light Industrial 	$50

Suppose you have to vote between the proposed **Additional Development Strategy** and **Current Development Trend**. Which one would you vote for?

- ○ Additional Development Strategy
- ○ Current Development Trend

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain

- ○ Neither Certain nor Uncertain
- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Development Strategy**, please indicate which aspect you think is most important to you with respect to developed uses.

- ○ Increase local employment
- ○ Increase property tax revenue
- ○ Expansion of public services
- ○ Easier access to consumer goods
- ○ More available housing

Block 9

Consider an **additional development strategy** that would cause the conversion of 1000 acres of farmland from the current agricultural use of livestock grazing on native pasture to the replacement type of urban development of retail. The additional development strategy would result in a one-time reduction in property tax or rent of $600 to each taxpayer in your area.

Current Development Trend
2000-2016 development trend continues

Additional Development Strategy		
Type of Current Agricultural Use	Type of replacement urban development	One-time reduction in property tax or rent to each taxpayer in your area ($)
Livestock Grazing on Native Pasture 	Retail 	$600

Suppose you have to vote between the proposed **Additional Development Strategy** and **Current Development Trend.** Which one would you vote for?

- ○ Current Development Trend
- ○ Additional Development Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain
- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Development Strategy**, please indicate which aspect you think is most important to you with respect to developed uses.

- ○ Increase local employment
- ○ Increase property tax revenue
- ○ Expansion of public services
- ○ Easier access to consumer goods
- ○ More available housing

Block 10

Consider an **additional development strategy** that would cause the conversion of 1000 acres of farmland from the current agricultural use of grain or oilseed farming to the replacement type of urban development of residential. The additional development strategy would result in a one-time reduction in property tax or rent of $1000 to each taxpayer in your area.

Current Development Trend
2000-2016 development trend continues

Additional Development Strategy		
Type of Current Agricultural Use	Type of replacement urban development	One-time reduction in property tax or rent to each taxpayer in your area ($)
Grain or Oilseed Farming 	Residential 	$1000

Suppose you have to vote between the proposed **Additional Development Strategy** and **Current Development Trend**. Which one would you vote for?

- ○ Additional Development Strategy
- ○ Current Development Trend

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain
- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Development Strategy**, please indicate which aspect you think is most important to you with respect to developed uses.

- ○ Increase local employment
- ○ Increase property tax revenue
- ○ Expansion of public services
- ○ Easier access to consumer goods
- ○ More available housing

Block 11

Consider an **additional development strategy** that would cause the conversion of 1000 acres of farmland from the current agricultural use of livestock grazing on native pasture to the replacement type of urban development of residential. The additional development strategy would result in a one-time reduction in property tax or rent of $50 to each taxpayer in your area.

Current Development Trend
2000-2016 development trend continues

Additional Development Strategy		
Type of Current Agricultural Use	Type of replacement urban development	One-time reduction in property tax or rent to each taxpayer in your area ($)
Livestock Grazing on Native Pasture 	Residential 	$50

Suppose you have to vote between the proposed **Additional Development Strategy** and **Current Development Trend**. Which one would you vote for?

- ○ Current Development Trend
- ○ Additional Development Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain
- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Development Strategy**, please indicate which aspect you think is most important to you with respect to developed uses.

- ○ Increase local employment
- ○ Increase property tax revenue
- ○ Expansion of public services
- ○ Easier access to consumer goods
- ○ More available housing

Block 12

Consider an **additional development strategy** that would cause the conversion of 1000 acres of farmland from the current agricultural use of grain or oilseed farming to the replacement type of urban development of retail. The additional development strategy would result in a one-time reduction in property tax or rent of $300 to each taxpayer in your area.

Current Development Trend
2000-2016 development trend continues

Additional Development Strategy		
Type of Current Agricultural Use	Type of replacement urban development	One-time reduction in property tax or rent to each taxpayer in your area ($)
Grain or Oilseed Farming 	Retail 	$300

Suppose you have to vote between the proposed Additional Development Strategy and Current Development Trend. Which one would you vote for?

- ○ Current Development Trend
- ○ Additional Development Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain
- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Development Strategy**, please indicate which aspect you think is most important to you with respect to developed uses.

- ○ Increase local employment
- ○ Increase property tax revenue
- ○ Expansion of public services
- ○ Easier access to consumer goods
- ○ More available housing

Block 13

Consider an **additional development strategy** that would cause the conversion of 1000 acres of farmland from the current agricultural use of grain or oilseed farming to the replacement type of urban development of residential. The additional development strategy would result in a one-time reduction in property tax or rent of $50 to each taxpayer in your area.

Current Development Trend
2000-2016 development trend continues

Additional Development Strategy		
Type of Current Agricultural Use	Type of replacement urban development	One-time reduction in property tax or rent to each taxpayer in your area ($)
Grain or Oilseed Farming 	Residential 	$50

Suppose you have to vote between the proposed Additional Development Strategy and Current Development Trend. Which one would you vote for?

- ○ Additional Development Strategy
- ○ Current Development Trend

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain
- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain
- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Development Strategy**, please indicate which aspect you think is most important to you with respect to developed uses.

- ○ Increase local employment
- ○ Increase property tax revenue
- ○ Expansion of public services
- ○ Easier access to consumer goods
- ○ More available housing

Block 14

Consider an **additional development strategy** that would cause the conversion of 1000 acres of farmland from the current agricultural use of commercial vegetable farm to the replacement type of urban development of retail. The additional development strategy would result in a one-time reduction in property tax or rent of $300 to each taxpayer in your area.

Current Development Trend
2000-2016 development trend continues

Additional Development Strategy		
Type of Current Agricultural Use	Type of replacement urban development	One-time reduction in property tax or rent to each taxpayer in your area ($)
Commercial Vegetable Farm 	Retail 	$300

Suppose you have to vote between the proposed Additional Development Strategy and Current Development Trend. Which one would you vote for?

- ○ Current Development Trend
- ○ Additional Development Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain

- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain
- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Development Strategy**, please indicate which aspect you think is most important to you with respect to developed uses.

- ○ Increase local employment
- ○ Increase property tax revenue
- ○ Expansion of public services
- ○ Easier access to consumer goods
- ○ More available housing

Block 15

Consider an **additional development strategy** that would cause the conversion of 1000 acres of farmland from the current agricultural use of commercial vegetable farm to the replacement type of urban development of residential. The additional development strategy would result in a one-time reduction in property tax or rent of $300 to each taxpayer in your area.

Current Development Trend
2000-2016 development trend continues

Additional Development Strategy		
Type of Current Agricultural Use	Type of replacement urban development	One-time reduction in property tax or rent to each taxpayer in your area ($)
Commercial Vegetable Farm 	Residential 	$300

Suppose you have to vote between the proposed Additional Development Strategy and Current Development Trend. Which one would you vote for?

- ○ Current Development Trend
- ○ Additional Development Strategy

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain

- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain
- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Development Strategy**, please indicate which aspect you think is most important to you with respect to developed uses.

- ○ Increase local employment
- ○ Increase property tax revenue
- ○ Expansion of public services
- ○ Easier access to consumer goods
- ○ More available housing

Block 16

Consider an **additional development strategy** that would cause the conversion of 1000 acres of farmland from the current agricultural use of livestock grazing on native pasture to the replacement type of urban development of light industrial. The additional development strategy would result in a one-time reduction in property tax or rent of $600 to each taxpayer in your area.

Current Development Trend
2000-2016 development trend continues

Additional Development Strategy		
Type of Current Agricultural Use	Type of replacement urban development	One-time reduction in property tax or rent to each taxpayer in your area ($)
Livestock Grazing on Native Pasture 	Light Industrial 	$600

Suppose you have to vote between the proposed **Additional Development Strategy** and **Current Development Trend.** Which one would you vote for?

- ○ Additional Development Strategy
- ○ Current Development Trend

How certain are you that this is the choice you would make in an actual vote?

- ○ Very Certain

- ○ Somewhat Certain
- ○ Neither Certain nor Uncertain
- ○ Somewhat Uncertain
- ○ Very Uncertain

If you voted for the proposed **Additional Development Strategy**, please indicate which aspect you think is most important to you with respect to developed uses.

- ○ Increase local employment
- ○ Increase property tax revenue
- ○ Expansion of public services
- ○ Easier access to consumer goods
- ○ More available housing

follow-up questions

Section E This section asks you some follow-up questions

Question 1

When voting, how important was each of the following attributes to you?

	Not At All Important	Unimportant	Neither Unimportant Nor Important	Important	Very important

	Not At All Important	Unimportant	Neither Unimportant Nor Important	Important	Very important
Type of Current Agricultural Use	○	○	○	○	○
Type of replacement urban development	○	○	○	○	○
One-time additional reduction in property tax or rent to each taxpayer in your area	○	○	○	○	○

Question 2

How likely do you feel the strategies presented in the survey could be really implemented?

- ○ Very Likely
- ○ Somewhat Likely
- ○ Uncertain
- ○ Somewhat Unlikely
- ○ Very Unlikely

Question 3

Do you have any other comments about the content of this survey or the reasons for your answers?

demographics

Section F The next set of questions is about you

Q1: What is your gender?

- ○ Male
- ○ Female
- ○ Other

Q2: What is your age? Please specify the number of years

Q3: Where do you currently reside?

- ○ In a city

- ○ Outside of a city
- ○ Others, please specify

Q4: What is your postal code? Please specify 6 digits

Q5: What is your residential and land ownership status?

	Yes	No
You own your residence	○	○
Your rent your residence	○	○
You own agricultural land	○	○

Q6: Which of the following is the highest level of education you have completed?

(PLEASE CHECK ONE RESPONSE ONLY)

- ○ Lower than high school
- ○ Completed high school

- ○ Completed post-secondary technical school
- ○ Completed university undergraduate degree
- ○ Completed post-graduate degree (e.g., Master or Ph.D.)

Q7: What is your current employment status?

(PLEASE CHECK ONE RESPONSE ONLY)

- ○ Working part-time (self-employed or employed by others)
- ○ Working full-time (self-employed or employed by others)
- ○ Retired
- ○ Student
- ○ Unemployed
- ○ [ ] Other, please specify

Q8: Which listed category best describes your total household income (before tax)?

- ○ Less than $30,000
- ○ $30,000 - $59,999
- ○ $60,000 - $89,999
- ○ $90,000 - $119,999
- ○ $120,000 - $149,999
- ○ Greater than $150,000

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