

# Environmental Impacts Beyond Edmonton's Borders

## *Why we should be worried about butterflies in Africa*

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### About Stantec

Stantec provides professional consulting services in planning, engineering, architecture, interior design, landscape architecture, surveying, environmental sciences, project management, and project economics for infrastructure and facilities projects. We support public and private sector clients in a diverse range of markets, at every stage, from initial concept and financial feasibility to project completion and beyond. Our services are offered through approximately 9,300 employees operating out of more than 150 locations in North America.

Stantec is recognized as a world-class leader and innovator in the delivery of sustainable solutions. Our Sustainable Development practice area is responsible for coordinating performance improvement projects which reduce the environmental and social impacts of our organization as well as growing Stantec's sustainability consulting business. We help organizations enhance their performance by identifying, planning for, and realizing social, environmental and economic improvements. Within the broad framework of our integrated sustainability practice, we provide a single source for comprehensive planning, policies, and program development for clients as small as a single office, to multi-national corporations and to community and government organizations.

### Biography

Laura launched Stantec's corporate sustainability program in 2006 and led this initiative until 2009. During this time she developed, implemented, and coordinated a variety of programs to reduce the organization's environmental and social impacts. Laura continues to play a key role in the ongoing development of Stantec's sustainability strategy while helping clients transition sustainability challenges into market opportunities. Her areas of expertise include corporate social responsibility, sustainability reporting, environmental education and engagement, transportation demand management, campus sustainability, sustainable procurement, and green building operations. She is a LEED® accredited professional and an Associate of LEAD Canada. She is also an instructor for the Northern Alberta Institute of Technology, where she teaches a course on Green Events.

## **Abstract**

Cities do not exist in isolation – they are dependent upon global environmental conditions and issues. This paper explores critical global environmental issues that exist beyond Edmonton's borders, including: natural resource depletion, climate change, water supply and quality, air quality, deforestation, soil depletion, desertification and drought, food production/ security, and biodiversity loss. We look at the causes and effects of each issue, along with its potential environmental, social, and economic impacts for Edmonton over time. A poll of subject-matter experts was used to gain some insight into which of these issues are currently viewed to be the most critical. Lastly, we discuss ways that Edmonton could respond to these global issues in order to prevent, mitigate, or adapt to the potential consequences.

# **Discussion Paper**

## **Introduction**

The fluttering of a butterfly's wings in Africa can cause a tornado in Edmonton. While this statement may sound ridiculous, it is in fact a possibility. Known as the butterfly effect, it points to a reality of the planet we all live on: everything is interconnected. All of us – humans, animals, plants, and other life forms – exist together in one global system called planet earth. Like all systems, a change of conditions in one part of the system, no matter how small, can cause even large-scale changes in another part of the system over time. It is therefore critical that to ensure a healthy environment for Edmontonians, we consider the impact of global environmental issues.

## **Edmonton: A Global City**

Cities do not exist in isolation – they are dependent upon global environmental conditions and issues. People have a tendency to believe that issues in another part of the world are 'their problems', and to remain primarily concerned with 'our problems' – things that are taking place around us right at this very moment. However, in this era of globalization, what happens 'over there' directly affects our reality 'right here', and the magnitude of these impacts can increase over time. Take the example of climate change: around 80% of the accumulated carbon dioxide in the atmosphere has been released by just 20% of the globe's population – the richest 20% of us who consume almost 80% of the world's resources<sup>1</sup>. Yet the impacts of climate change will be felt the most harshly by the poorer 80% of the global population who did little to contribute to it, as they are the most vulnerable to its impacts and the least capable of adapting to them. This inequity is one of the realities of globalization today and it demonstrates how no place on earth is immune to global environmental issues.

Concurrent to globalization is the trend of urbanization. In 2009, the amount of people in the world living in cities surpassed those living in rural areas and it is expected that by 2050, the percentage of the world's population living in cities will have increased to 75%<sup>2</sup>. Most of this urban growth will take place in lesser developed countries. This move from countryside to cities will have a significant impact on how we consume and distribute resources. Cities take up only about 2% of the Earth's surface but they account for around 75% of the world's energy demand, produce 80% of the greenhouse gases, and have large material consumption<sup>2</sup>. Cities can also have many positive benefits, as concentrating humans in urban areas enables greater access to public services and utilities such as health care, education, electricity, and clean water and it can also render transportation of goods, services, and people more efficient.

As the human population moves away from subsistence-based agrarian lifestyles, we become increasingly dependent on transportation networks and the global economic system. For example, if food delivery networks were disrupted, it's estimated that a city such as Toronto could feed itself for just 3 days<sup>3</sup>. Edmonton is not likely to fare any better. This demonstrates that in our current system, humans living in cities are very vulnerable to catastrophe. In order to build more resilient communities, we need to become less dependent upon global distribution networks and to invest more in local production of goods, services, and knowledge. This is especially important in a heavily urbanized nation like Canada, where 80% of people live in cities<sup>4</sup>.

As a mid-sized developed city in a northern latitude, Edmonton is a quintessential 'global city' that is particularly dependent upon distribution networks and is thus highly susceptible to global issues. Below we will explore some of the global environmental issues that are deemed critical today and discuss their potential ecological, social, and economic impacts for Edmonton. In order to become a more resilient community and to reduce our susceptibility to crises, Edmonton needs to be aware of these global issues and to build the capacity to respond appropriately. By developing local strategies for preventing, mitigating, or adapting to the potential consequences of global issues, Edmonton can help to build a more sustainable future for its residents at the same time as it contributes to building a more sustainable future for everyone.

## **Global Environmental Issues**

We are depleting the earth of ecosystem elements that we depend on, such as stable climates, fresh water, clean air, productive forests, prime soil, arable land, and diverse species, thus causing climate change, water supply and quality issues, deforestation, soil degradation, desertification and drought, and biodiversity loss. All of these issues feed into each other detrimentally and they will all impact Edmonton in different but interrelated ways.

## ***Natural resource depletion***

The most significant environmental challenge facing humanity today is natural resource depletion, which contributes to all other global environmental issues. Tied into natural resource depletion is the issue of waste management, as consumption of natural resources produces large amounts of waste. Humans often seem to forget that we live in a closed system. The carrying capacity of the Earth is finite – we cannot continue reproducing and consuming indefinitely. Currently the footprint of humanity is larger than the global carrying capacity of the earth, which means that we are consuming resources faster than they can be produced or processed. This is primarily due to two factors: over-consumption and population growth.

Human consumption is steadily increasing. Global resource use has expanded 50% over the past three decades, despite a 30% increase in resource efficiency<sup>5</sup>. It now takes 4 million pounds of materials in order to meet the needs and wants of one average middle-class North American family for a year<sup>6</sup>. An ecological footprint shows how much biologically productive land and water we need to produce all the resources we consume and to absorb our waste<sup>7</sup>. The available global biocapacity per person is 1.90 hectares, yet the average person on Earth already uses 2.3 hectares<sup>8</sup>. This means that humans are already consuming resources at such a rapid rate that if our habits continue unimpeded, we will require multiple planets to satisfy our needs. We only have one. This unsustainable trend occurs because our current economic system does not account on the balance sheet for natural capital such as ecological services, even though they form the fundamental basis for all economic activity. As a result, resources which are seen as ‘free’ are rapidly depleted beyond their capacity to regenerate. In any sustainable business, you must live off the interest of your resources, not the capital. Humans are essentially living off the Earth’s capital (its biological capacity), instead of its interest (renewable resources)<sup>6</sup>.

Natural resource depletion is compounded by rapid population growth. It is estimated that the human population will increase from 6.8 billion today to over 9 billion by 2050<sup>9</sup>. Nearly all of this growth is expected to occur in developing countries, which currently account for 80% of the global population. People in the developing world consume a fraction as many resources as the average Canadian. Improving their quality of life will require increased levels of consumption and thus increased resource depletion. As the average ecological footprint is already greater than the earth’s carrying capacity, it is not possible for the rest of the global population to attain the levels of consumption of the developed world without bringing the planet to the brink of collapse. In order to reduce poverty in the developing world, we thus have two options in the developed world: dramatically reduce consumption or dramatically increase resource efficiency. Otherwise we will be denying the needs of the poor in order to fulfill our wants.

Global natural resource depletion has many potential environmental, social, and economic impacts for Edmonton. The average Canadian has the third largest ecological footprint in the world – 7.25 hectares per person<sup>7</sup>. This means that we consume a disproportionate share of the Earth's resources – almost 4 times the average. We are fortunate that Canada is a vast and sparsely populated country, thus we technically have a domestic surplus of natural capital. However, this pattern is not sustainable, nor equitable. Within Canada, Edmonton has one of the highest average ecological footprints of any municipality. At 9.45 hectares per person, we are second only to Calgary<sup>7</sup>. This is partially due to our northern location and the type of energy predominant in Alberta. However, it also signifies a significant problem for Edmonton: we consume far too much and we are too dependent upon imported resources such as food and non-renewable resources such as natural gas. As energy prices increase, there may come a day where a much larger portion of the population simply cannot afford food or to stay warm in the winter, with drastic social consequences.

Some key strategies that Edmonton could use to prevent, mitigate, or adapt to the potential consequences of global natural resource depletion are:

- Reduce consumption of natural resources
- Increase resource efficiency

### ***Climate change***

Climate change is one of the most critical global environmental issues facing humanity today, as it impacts all other issues. Climate change refers to the changes in our climate caused by the warming of the global surface temperature. The primary cause of climate change is increased concentrations of greenhouse gases resulting from human activity. When we mine fossil fuels trapped underground, this releases ancient carbon into the environment that would otherwise not have re-entered the carbon cycle for eons, thus significantly disrupting the equilibrium of our atmosphere. The total long-term amount of greenhouse gases in the atmosphere is currently 455ppm (parts per million) carbon dioxide equivalents<sup>10</sup>. This has already surpassed 450ppm, the safe upper limit agreed upon by the Intergovernmental Panel on Climate Change (IPCC), and far exceeds 350ppm, the recommended limit endorsed by many global scientists, including Rajendra Pachauri, the chair of the IPCC, and Sir Nicholas Stern, former senior vice president of the World Bank and author of the 2006 Stern Review on the Economics of Climate Change. The current trajectory of climate change is now much worse than the most pessimistic projections, as we have already seen significant melting of glaciers and ice sheets that was not predicted to occur for several more decades.

Global climate change has many potential environmental, social, and economic impacts for Edmonton. For example, climate change is predicted to reduce water availability in Alberta<sup>11</sup>. Climate change could also cause more dramatic fluctuations in local temperatures, resulting in colder winters and hotter summers.

This will impact local food production. Bigger temperature swings will also necessitate higher energy use and could lead to greater incidences of weather-induced health problems such as asthma and heat stroke. Climate change can also result in a greater number and intensity of storms, which can cause damage to property and infrastructure.

Some key strategies that Edmonton could use to prevent, mitigate, or adapt to the potential consequences of global climate change are:

- Prevention/ Mitigation
  - Develop more stringent energy efficiency standards for all new buildings and encourage retrofitting of older buildings.
  - Increase electricity generation from renewable energy sources, including wind, solar, geothermal, and biomass.
  - Discourage urban sprawl and encourage development of the downtown core.
  - Improve infrastructure and incentives for low carbon transportation modes, including transit, carpooling, cycling, and walking.
- Adaptation
  - Develop and regularly update a municipal climate change plan involving all city departments and other key stakeholders.
  - Develop training programs for workers needed in emerging industries such as renewable energy, energy efficiency, and alternative fuels

### ***Water supply and quality***

Climate change can cause reductions in water supply and quality – two critical global environmental issues. Water is life – life can survive without oxygen, without light, or at extreme temperatures – but nothing can live without water. We are diverting water, overmining groundwater, and deforesting, degrading, and paving over essential natural systems that help with water collection. Thus water promises to be to the 21<sup>st</sup> century what oil was to the 20<sup>th</sup> century: the precious commodity that determines the wealth of nations<sup>12</sup>. It is being labeled the ‘blue gold’ of today. More frighteningly, the next world war may be fought over water. Water has become susceptible to geopolitical tensions and many cross-border disputes now revolve around water rights and supply. As global freshwater supply peaks, so will global food production, which will have severe impacts for humanity.

Serious water shortages now occur on every continent and they are spreading rapidly. The earth's fresh water is finite and small, representing less than one half of 1 percent of the world's total water stock, and only a small portion of that is renewable and thus regularly replenished<sup>13</sup>. About one third of the world's population lives in countries with moderate-to-high water stress, defined as water consumption that exceeds 10% of renewable freshwater resources<sup>14</sup>. This includes most of the world's megacities. Not only are we adding 85 million new



people to the planet every year, but our per capita use of water is also doubling every twenty years, at more than twice the rate of human population growth<sup>13</sup>. Even the United States is in a water crisis: the Ogallala aquifer, which serves one fifth of their irrigated land, is being depleted eight times faster than nature can replenish it, parts of it by as much as 50%<sup>15</sup>. As global fresh water shortages become more and more common, there will be increased pressure to export water from countries with a perceived surplus, such as Canada. With only 0.5% of the world's population, we have around 20% of the earth's fresh water, including about 9% of the renewable supply<sup>16</sup>. Many view Canada's plentiful water sources with an eye for profit and envision selling it in bulk to regions in need, such as the United States. Not only is this an unsustainable solution, but as water provides ecosystem services, removing it may negatively impact our environment.

Decreasing water quality is another big concern. More than three million people die every year from avoidable water-related disease<sup>17</sup>. In the developing world, it is estimated that more than 90% of sewage is discharged directly into rivers, lakes, and coastal waters without treatment of any kind<sup>17</sup>. In addition, industrial agriculture often uses toxic chemicals such as fertilizers, pesticides, and herbicides which pollute water both above and below ground. Water quality issues are thus a self-perpetuating cycle of overuse, waste, and pollution.

Global reductions in water supply and quality have many potential environmental, social, and economic impacts for Edmonton. In Alberta, we are starting to experience frequent water shortages which will be exacerbated by the rapid expansion of water-intense industries. This is already causing significant stress for our agricultural economy. If current trends continue, we may see chronic water shortages that hinder health, threaten food production, and negatively impact ecosystems and other species. In addition, if water starts going to the highest bidder, it may become difficult to secure enough to meet Edmonton's needs, even though we might have plenty of water in our region.

Some key strategies that Edmonton could use to prevent, mitigate, or adapt to the potential consequences of global changes in water supply and reduced global water quality are:

- Prevention/ Mitigation
  - Promote good water management practices such as conservation and rainwater harvesting
  - Encourage development of more stringent residential and commercial water use and pollution regulations as well as increased enforcement
  - Develop more stringent water efficiency standards for buildings and water-using appliances
  - Upgrade broken and inefficient water and wastewater infrastructure
  - Promote green roofs and use of native plants in landscaping
- Adaptation

- Develop an inter-district water resources management plan involving all city departments and other key stakeholders.

### ***Air quality***

Another global environmental issue which is closely linked to climate change is the depletion of clean air – an essential resource. Air pollution is the introduction of harm-inducing chemicals, particulate matter, or biological materials into the atmosphere. These pollutants can become dangerous to human health if people are sensitive to elevated levels or are exposed to them for extended periods<sup>18</sup>. Two primary pollutants are sulfur dioxide, produced from industrial processes, and nitrogen dioxide, emitted from combustion vehicles. A third major pollutant is carbon dioxide, which causes climate change. Chlorofluorocarbons (CFCs), another dangerous pollutant, contribute to the depletion of the ozone layer, thus increasing exposure to ultraviolet light which may cause increases in skin cancer, damage to plants, and reduction of ocean plankton populations. The eruption of Iceland's Eyjafjallajökull volcano illustrated to the world that pollutants travel easily and quickly through the atmosphere, thus we should all be concerned about global air pollution, no matter where it originates. Air pollution can have serious consequences for human beings, both directly by causing health problems and indirectly by impacting the ecosystems on which we depend.

Global reduction in air quality has many potential environmental, social, and economic impacts for Edmonton. Edmonton's air quality is decreasing. Power plants and refineries in the area are releasing larger amounts of heavy metals<sup>19</sup>. In fact, Edmonton has seen a six-fold jump in lead emissions from local industry since 1994 and a 19% increase in mercury since 2000<sup>19</sup>. Lead can have severe consequences for human health, especially for children. In the industrial heartland area north-east of Edmonton, one study found concentrations of some contaminants at levels above those in Mexico City<sup>19</sup>. In addition, we are starting to see smog more regularly, which can lead to increased respiratory problems and thus increased health care costs. As Edmonton's air pollution won't stay within our city limits, we have an obligation to try and minimize it as much as possible in the hope that other municipalities will do the same.

Some key strategies that Edmonton could use to prevent, mitigate, or adapt to the potential consequences of reduced global air quality are:

- Prevention/ Mitigation
  - Encourage development of more stringent air pollution regulations as well as increased enforcement
  - Encourage a shift to electricity generated from renewable sources of energy including wind, solar, geothermal, and biomass.
  - Improve infrastructure and incentives for low carbon transportation modes, including transit, carpooling, cycling, and walking.
- Adaptation



- Develop a municipal air quality and climate change action plan involving all city departments and other key stakeholders.

## **Deforestation**

Deforestation is another significant global environmental problem. Deforestation is the long-term or permanent loss of forest cover and its transformation into another land use, and it has many consequences. Forests provide valuable products such as wood, dyes, fibers, oils, resins, fruits, and nuts. They also perform essential ecosystem services such as maintaining local climate, filtering water, providing oxygen, and absorbing carbon dioxide. In addition, forests support incredible biodiversity, thus providing us with potential crops and medicines which may be essential for survival one day.

Deforestation is one of the greatest forces of global environmental change and one of the biggest contributors to biodiversity loss. About half of the forests that once covered the earth are gone, and each year another 16 million hectares disappear<sup>20</sup>. Deforestation is accelerating into as-yet undisturbed areas and the quality of remaining forests is declining. The vast majority of deforestation now occurs in the tropics such as Latin America and Asia, where deforestation is occurring at a rate of about 2% a year<sup>20</sup>. For communities who typically live in and are dependent upon forests, deforestation is socially and economically devastating. For example, forests are often cut down for mono-culture food production, which can lead to a loss of top soil, a loss of nutrients, and then desertification. Irrigation, nitrogen fertilizer, and pesticides are all just quick fixes that will degrade the quality of soil over time.

Global deforestation has many potential environmental, social, and economic impacts for Edmonton. The forest products industry is Alberta's third largest economic sector, thus unsustainable forest management may lead to large reduction in revenue over time<sup>21</sup>. Deforestation will invariably lead to poor soil quality and eventually desertification, decreasing the food production capacity of the region. Due to diminished filtration services of the forests, deforestation will also lead to reduced water quality which can negatively impact health. Another risk is biodiversity loss, which can reduce Edmonton's ability to withstand future crises and also reduces its draw for tourism, another major industry.

Some key strategies that Edmonton could use to prevent, mitigate, or adapt to the potential consequences of global deforestation are:

- Prevention/ Mitigation
  - Increase local protected forest areas
  - Discourage urban sprawl
  - Use forest products certified by the Forest Stewardship Council (FSC)
- Adaptation
  - Find alternate sources for forest products

- Support migration and retraining for communities affected by deforestation

### ***Soil depletion***

Deforestation can lead to soil depletion - another core global environmental issue. Soil depletion is a decrease in soil quality over time, exhibited by a decrease in minerals and organic matter. It is caused by a loss of nutrients resulting from the combined effects of increased population densities, deforestation, overfarming, overgrazing, wind erosion, overuse of synthetic fertilizers and herbicides, poor irrigation practices, or acid rain.

It's estimated that each year more than 10 million hectares of crop land are degraded or lost as rain and wind sweep away topsoil<sup>22</sup>. Soil is often lost much faster than it can naturally regenerate, and attempts to irrigate arid lands often produce soils so salty that nothing will grow. Only 5% of Canada's land is not hampered by severe constraints for crop production and only 0.5% of land is Class 1 soil<sup>23</sup>. Of the 17% of Alberta land that is good for farming, most of that is in the Edmonton to Calgary corridor along with 75% of Alberta's population<sup>24</sup>. Within the Edmonton city limits, we are gifted with prime agricultural soils (Class 1, 2, & 3), a longer growing season than anywhere else in Central or Northern Alberta, and more moisture than southern Alberta. However, Edmonton has lost 74% (17,000 Ha) of its Class 1 soils since 1982<sup>23</sup>.

Global depletion of soil has many potential environmental, social, and economic impacts for Edmonton. Once soil is depleted of its minerals, it produces less nutritional crop, thus soil depletion directly impacts food production. This in turn can lead to decreased human health and increased risk of disease. Soil depletion also leads to desertification, therefore it can cause increased downstream flooding, reduced water quality, and loss of livelihood thus forcing migration.

Some key strategies that Edmonton could use to prevent, mitigate, or adapt to the potential consequences of global soil depletion are:

- Prevention/ Mitigation
  - Discourage urban sprawl
  - Encourage better soil management
- Adaptation
  - Support migration and retraining for communities whose livelihoods are affected
  - Find alternate sources for food

### ***Desertification and drought***

Soil depletion and deforestation are two of the primary causes of desertification and drought, which have equally significant global environmental impacts. Desertification is the loss of biological or economic productivity and complexity in

drylands, which includes croplands, pastures, and woodlands<sup>25</sup>. Desertification is caused primarily due to climate variability and unsustainable human activities such as deforestation, overcultivation, overgrazing, and poor irrigation practices<sup>25</sup>. By contrast, drought is a natural phenomenon that occurs when rainfall is significantly below average for an extended period of time. One of the impacts of climate change is anticipated to be an increase in droughts.

Today, a third of the Earth is threatened by desertification<sup>26</sup>. It threatens the lives of some 1.2 billion people in 110 countries who are among the world's poorest and who depend primarily on the land for their needs<sup>26</sup>. Each year desertification and drought causes an estimated \$42 billion in lost agricultural production<sup>26</sup>. Continued population growth compounded with increased competition for land is expected to lead to increased desertification. Traditional strategies for avoiding desertification such as shifting agriculture and nomadic herding have become less practical due to population growth, changing economic and political conditions, and a decrease in nomadic lifestyles<sup>25</sup>.

Global desertification and drought have many potential environmental, social, and economic impacts for Edmonton. Land impacts of desertification include decreased soil productivity, damaged vegetation, reduced food production, and reduced resilience to natural climate variability<sup>27</sup>. Impacts for surrounding communities can include downstream flooding, dust storms, sedimentation or siltation in water bodies, reduced water quality, and aggravated health problems<sup>27</sup>. Severely affected land may become inhabitable or may lead to loss of livelihood, forcing relocation and creating populations of environmental refugees.

Some key strategies that Edmonton could use to prevent, mitigate, or adapt to the potential consequences of global desertification and drought are:

- Prevention/ Mitigation
  - Encourage sustainable land management
  - Encourage good irrigation practices
  - Reduce deforestation
- Adaptation
  - Support migration and retraining for affected communities
  - Find alternate sources for food
  - Construct flood protection mechanisms in at-risk areas

### ***Food production/ security***

Climate change, soil depletion, and changes in water supply are all negatively impacting food production and security. This is a global issue of critical importance because all of us need to eat. Food security is when all people at all times can acquire safe, nutritionally adequate, and personally acceptable foods in a manner that maintains human dignity and works together with nature<sup>28</sup>. Four key elements of food security are production, transportation, waste, and quality.

Food production per capita has been declining for decades<sup>29</sup>, so it is now more difficult than ever for us to continue feeding the 6.8 billion people on Earth today. One billion people are currently malnourished or undernourished<sup>30</sup>. According to population growth estimates, we will have over 9 billion mouths to feed by 2050, and those people are expected to have longer life expectancies. To meet human nutritional needs over the next 40 years, global agriculture will therefore have to supply as much food as it has produced during all of human history<sup>31</sup>. This will be a challenge as most of the world's arable land is already under production.

Food transportation is also becoming an increased challenge. In today's global economy, individuals have very little control over our food sources. On average, most food in Canada travels 2,400 kilometers to get to your plate<sup>32</sup>. In the event of a 'food shock' such as severe drought or wide-spread transport-related strike, North American cities only have only a three day supply of fresh food<sup>3</sup>. This means that food production issues in Asia affect us in Edmonton. Drought in China can lead to decreased fruit production and thus higher fruit prices, which will result in lower supply and increased prices for the fruit we eat here in Edmonton. For our poorer populations, this might make oranges too expensive to eat, potentially leading to Vitamin C deficiencies and thus higher health care costs. Food distribution is highly dependent upon the global transportation network, thus increased oil prices will also lead to increased food prices and decreased supply. As the highest fertility rates are typically found in countries that are already struggling to feed their existing population, it is critical that we become more efficient at both producing and distributing food.

Food waste also impacts food security. The retail market has 38% food waste<sup>33</sup> due to inefficient food transportation and storage as well as the western culture of excess and waste. If we can reduce food waste, we can secure food for a much larger population without having to increase food production.

Lastly, food security is impacted by the drastic decrease in food quality. There has been an overall decline in the nutritional value of food produced today, which is in turn decreasing human health.

Global reduction in food production and security has many potential environmental, social, and economic impacts for Edmonton. At present, the Edmonton Food Bank provides meals to over 15,000 citizens, which demonstrates that there are already a significant number of people in Edmonton who regularly go hungry. As the global population rises and food prices climb, food will become inaccessible for an increasing number of Edmontonians. Alberta has the capacity to grow a lot of food. We have large amounts of agricultural land with fertile soils, ample clean water, and Edmonton has one of the longest growing seasons in all of Alberta. Increased local food production is thus possible, but we need to invest in it. Buying local food can lead to increased health benefits as this food is typically fresher and less processed. It also leads

to social and economic benefits by directing more investment into our local community. Another potential impact of reduced global food security is a decrease in meat production and an increase in growth of more natural foods. With the same-sized plot of land, far more people could be fed a vegetarian diet than a meat one. In fact, an acre of spinach produces 28 times more protein than an acre of pasture used for meat production<sup>34</sup>. In addition, more natural foods are typically healthier and less resource-intensive to grow.

Some key strategies that Edmonton could use to prevent, mitigate, or adapt to the potential consequences of global reduction in food production/ security are:

- Prevention/ Mitigation
  - Preserve high quality farmland in and around Edmonton
  - Encourage urban agriculture and local food production
  - Invest in training programs for new farmers around Edmonton
  - Decrease food waste
- Adaptation
  - Decrease meat production
  - Promote healthier, more natural foods

### ***Biodiversity loss***

Lastly, one overarching global environmental issue which is caused by all of the factors above is biodiversity loss. Biodiversity is the variation of life forms within a given ecosystem and it can be used as a measure of ecosystem health. Global biodiversity loss is occurring at an alarming rate. Species are disappearing exponentially faster than even just a few decades ago. Most of these species took thousands of years to evolve and once lost they will be gone forever.

Maintaining biodiversity on the planet is very important. The more diversity that we have in the gene pool, the greater is our ability to ensure that there will be animals and plants that can help us to adapt to changing global environmental conditions. For example, biodiversity provides us with potential crops and medicines which may be essential for survival one day. Many drugs that treat diseases such as leukemia or cancer were discovered from rare plant species whose uses were previously unknown. At present, less than 1 percent of tropical plants have been screened for possible use to medical science, so increased biodiversity loss results in the permanent loss to science of species before their potential value for humanity can be recognized<sup>20</sup>.

Global loss of biodiversity has many potential environmental, social, and economic impacts for Edmonton. Our river valley parks system is one of the cultural and recreational highlights of the city, and it is teeming with living things. Any biodiversity loss there would be a disappointment to the citizens who use its trails regularly and could negatively impact tourism. Many species live in a symbiotic relationship with each other and the loss of only one can impact the overall ecosystem dynamic. Loss of one species can also lead to invasion of

another species previously held at bay, which may have harmful qualities or be less aesthetic. Most importantly, biodiversity loss may make it more difficult to grow food in our harsh unique climate, as it can limit the availability of local plant species well suited to local growing conditions.

Some key strategies that Edmonton could use to prevent, mitigate, or adapt to the potential consequences of global biodiversity loss are:

- Prevention/ Mitigation
  - Preserve land around Edmonton
  - Discourage urban sprawl
  - Increase local protected forest areas
- Adaptation
  - Contribute local species to the global seed vault
  - Find alternate natural sources for products

## **Conclusion**

Current rates of natural resource depletion are unsustainable. Cities are a big part of the problem, thus they must be also be a key part of the solution. Cities need to play an increasingly significant role in tackling global environmental issues.

As a global city, Edmonton increasingly impacts and is impacted by global environmental conditions. In order to progress towards a world that is more environmentally, socially, and economically sustainable, we must always keep top of mind the global implications of our decisions. However, we should also recognize that our ability to create long-standing change is much greater in our local environment. By developing local strategies for preventing, mitigating, or adapting to the potential consequences of global issues, Edmonton can help to build a more sustainable future for its residents at the same time as it contributes to building a more sustainable future for everyone.

Many of the greatest civilizations on earth have collapsed due to over-exploitation of natural resources, which led to shortages of food and water and then regional or international conflicts<sup>29</sup>. In order to increase our immunity to a similar fate, Edmonton first and foremost needs to reduce our consumption of natural resources and to increase our resource efficiency. As all global issues are tied in with resource depletion, tackling this issue will help to build our capacity to respond appropriately to a wide variety of global threats. If we can reduce depletion of natural resources, we will reduce our dependency on global distribution networks and thus our susceptibility to crises. This is the first step to transitioning Edmonton into a more resilient global community.



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