# A Climate Change Analysis for the Future Health of the Sicangu Lakota Oyate



7Gen Plan

DRAFT (Updated 11/5/19)

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## **Executive Summary**

Annual average temperatures are objectively rising both locally and globally and there is an overwhelming scientific consensus that the increases are due to greenhouse gas emissions caused by human action. The impacts of climate change are already being felt around the world—including on the Rosebud Reservation—and will continue to intensify if not addressed immediately and strategically. Research from multiple reports have concluded that indigenous communities will be affected uniquely and disproportionately by climate change.

Locally, the most significant direct effects of climate change will be a rise in temperature and an increase in extreme precipitation events. In South Dakota, temperatures have risen by 2°F



Graphics from NCA4. Sources: NOAA NCEI and CICS-NC.

since the beginning of the 20th century, and that rise appears to be accelerating. At the same time, year-to-year precipitation has been highly variable, leading to both droughts and flooding.

Climate change has the potential to hurt the economy of the Rosebud Reservation. Given the combination of rising temperatures and unpredictable and extreme precipitation patterns, agriculture is likely to be impacted in the long run. However, rising temperatures would create a longer growing season, creating an opportunity in the short term to increase agricultural output through techniques such as agroforestry and other responsible farming practices. Additionally, flooding presents a threat to the already stressed infrastructure of the reservation. In addition to systems of communication, transportation, water, and sanitary infrastructure, pipelines will also be at an increased risk of damage.

In order to strategically address the threats of climate change, communities are enacting plans related to both adaptation and mitigation. Adaptation strategies include strategic land and water management and addressing the need for emergency response planning. Mitigation strategies aim to lower carbon emissions and include projects such as renewable energy, public transportation, recycling and composting, and encouraging citizens to reduce consumption. While reservation communities face unique legal and regulatory barriers, it is imperative that addressing climate change happens now and with the input and leadership of Indigenous communities.

# Key Takeaways by Section

#### An Introduction to Climate Change and the Sicangu Oyate

- The natural environment plays an important role in Lakota identity and spirituality.
- Indigeneous communities hold valuable knowledge regarding the interconnectedness of Unci Maka and historical climate variations.
- Traditionally, Lakota people were able to adapt to climate variations by relocating.
- A shrunken land base makes traditional adaptation strategies nearly impossible.

#### The Global Situation

- In recent decades, the global average temperature and atmospheric CO2 levels have increased in tandem.
- Scientists project that the temperatures will continue to rise at an increasing level, potentially leading to devastating consequences.
- Consequences include loss of surface ice, sea level rise, higher ocean temperatures, ocean acidification, increase in extreme weather events, all of which may bring on a mass extinction and huge economic impacts.
- Although scientists' projections vary, even the most optimistic models predict significant impacts around the world.

#### **Global Strategies**

- Responses to climate change must include both adaptation and mitigation strategies.
- Key adaptation strategies include evolving agriculture to match the changing climate and environmental needs, as well as disaster-resistant development.
- Mitigation strategies include a reduction in carbon emissions through means such as renewable energy, reduced consumption, carbon capture, as well as government regulation.
- The 2015 Paris Climate Agreement was the largest, coordinated effort among world governments to address climate change.

## The Local Situation

- Indigeneous groups are affected uniquely by climate change and are limited in their ability to respond.
- In South Dakota, average temperatures have risen 2°F since 1900 and are expected to increase more rapidly in the future with increases above 10°F possibly by the end of the century.
- Precipitation is expected to become more unpredictable and volatile from year to year, leading to more extreme storms, droughts, and flooding.
- These events threaten an already vulnerable infrastructure and economy.

## The Local Impact

- Experts predict there will be mass migrations in the US in coming decades, but that the effects to Rosebud will be more regional than local.
- The overall economic impact of climate change is projected to be slightly negative for Rosebud.
- Agriculture may see a short-term boom, but over the long term output will likely decrease.
- Infrastructure and public health will be threatened by climate change.

• The cultural impacts are unknown locally and should be studied further.

#### Water

- Overall, the volume of surface water and groundwater supplies are expected to remain steady or increase slightly.
- A growing population in urban areas of South Dakota and Nebraska along with limited access to water in other areas of the country could increase demand on the water supply of the Sicangu people.
- More extreme storms and flooding increase the vulnerability of pipelines (both oil and water) which threatens the local water supply
- Many areas of the economy and daily life would be affected by water cutoff or contamination
- Securing water rights is an urgent issue facing the Rosebud Sioux Tribe and a threat to the tribe's sovereignty.

#### Local Challenges and Opportunities

- Despite being a sovereign nation, the Rosebud Sioux Tribe will face legal, jurisdictional, and regulatory hurdles when taking action on climate change.
- Quantifying and securing water rights is a long and expensive process but has been linked to positive economic outcomes.
- Lack of disaster preparedness and emergency response planning present a threat to tribal citizens and the tribal economy.
- The Rosebud Reservation has enormous wind and solar energy potential.
- High unemployment means there is a large supply of workers to fill renewable energy jobs, if provided the right training.

## Local Strategies

- Securing water rights is an urgent issue facing the Rosebud Sioux Tribe and a threat to the Tribe's sovereignty which must be addressed.
- In order to avoid desertification and loss of soil nutrients, responsible land conservation policies must be enacted locally and lobbied for state-wide.
- An already-deteriorating infrastructure (unpaved and unmaintained roads) must be addressed before a catastrophic event endangers lives and the economy.
- The tribe should adopt an emergency response plan for various natural disasters that threaten the Sicangu Oyate.
- Renewable energy and microgrids must be urgently pursued to both combat carbon emissions and promote energy sovereignty.
- Improving public transportation, education, and tribal programs can educate tribal citizens on being better stewards for Unci Maka

# An Introduction to Climate Change and the Sicangu Oyate

<u>Key Takeaways:</u>

- The natural environment plays an important role in Lakota identity and spirituality.
- Indigeneous communities hold valuable knowledge regarding the interconnectedness of Unci Maka and historical climate variations.
- Traditionally, Lakota people were able to adapt to climate variations by relocating.
- A shrunken land base makes traditional adaptation strategies nearly impossible.

Since time immemorial, Lakota people have had an intimate relationship with and understanding of Unci Maka—Grandmother Earth. She is treated as a relative and sacred provider who must be listened to with the understanding that humans do not control the environment, but rather are one of it's many essential elements. This symbiotic relationship with the natural environment is integral to Lakotas' place-based social, cultural, and spiritual identity, cultural heritage, and subsistence practices and livelihoods. As the effects of climate change continue to grow, Indigenous groups will be impacted uniquely and in some cases disproportionately. However, being able to draw on deep traditional knowledge means that Native people have an important role in advancing the understanding of climate change and in developing a more comprehensive climate adaptation strategies.<sup>1</sup>

"Climate change" is not a new concept for the Lakota people. For centuries, the hunting and gathering society of the Lakota thrived and left a minimal footprint on the natural terrain. By responding to weather patterns and following the Tatanka across what would become known as the "American West," Lakota ancestors ensured that no area would become overrun or overused. Intimate knowledge of their ecosystem ensured that communities would be able to adapt and thrive in a variety of climate conditions.<sup>35</sup>

However, as society and jurisdiction have changed with colonization, adaptation in today's world presents many more challenges than it did to Lakota ancestors. In the days before treaties and reservations, Native people were able to relocate and readjust freely, but that changed with the arrival of white settlers. After land was divided up through such policies as the Homestead Act (1862) and Dawes Act (1887) and given to individuals, tribal populations were extremely limited in their ability to relocate or continue with their traditional subsistence ways of life. As generations have gone by, the efforts of acculturation have continued by means of forced assimilation and Western education, and the Native land base has dwindled to a tiny fraction of what it once was. This has led to tribal knowledge and ways of being having been lost, resulting in the physical, mental, and spiritual suffering of Lakota people.<sup>2</sup>

Additionally, there is convincing evidence and a virtual scientific consensus that the climate change that has been experienced in recent decades has been brought about by humans, which makes today's iteration of climate change unique. The evidence will be discussed in a subsequent section, but it suggests that societies may need to shift their values away from a purely capitalistic mindset to one that includes a more holistic and balanced approach that includes long-term strategic planning related to the environment and its ecosystems.<sup>2</sup>

Through the many challenges and attempted genocide, Lakotas have always maintained a distinct connection to the planet. Western society now looks to Indigenous people—"the original environmentalists"—to be an important part of advancing the understanding of climate change and identifying effective strategies for both adaptation and mitigation. In the following sections of this report, we will identify the evidence and effects of a warming climate both globally and locally, and examine strategies that are being employed globally and how the Sicangu Oyate fits into the picture.

# The Global Situation

<u>Key Takeaways:</u>

- In recent decades, the global average temperature and atmospheric CO2 levels have increased in tandem.
- Scientists project that the temperatures will continue to rise at an increasing level, potentially leading to devastating consequences.
- Consequences include loss of surface ice, sea level rise, higher ocean temperatures, ocean acidification, increase in extreme weather events, all of which may bring on a mass extinction and huge economic impacts.
- Although scientists' projections vary, even the most optimistic models predict significant impacts around the world.

Despite what some American politicians suggest, the evidence for climate change—and the human race's contribution to it—is overwhelming and virtually uncontested in the scientific community.<sup>3</sup> It is also worth noting that the concern over climate change is not new, nor has it always been treated in a bipartisan manner. In 1990, after a unanimous 100-0 vote in the Senate, Republican president George H.W. Bush signed into law the Global Change Research Act which requires that a report be presented to Congress every four years outlining the environmental, economic, and societal impacts of climate change. The report—known as the National Climate Assessment—is compiled by an interagency coalition of experts and analyzes

the latest research from around the globe.<sup>4</sup> The most recent special report was published in 2018 and concluded that "it is extremely likely that human activities, especially emissions of greenhouse gases are the dominant cause of the observed warming since the mid-20th century."<sup>5</sup> The report has become so highly-demanded that state-by-state summaries are now released as well.<sup>18,19</sup>

The United Nations' Intergovernmental Panel on Climate Change (IPCC) is another source for comprehensive information on climate change. The panel's fifth assessment report (AR5), published in 2014, details the global consequences of climate change. The report synthesizes research by thousands



of experts from around the world related to the most recent developments in climate science, adaptation, vulnerability, and mitigation and is considered by governments around the world to be the most comprehensive and reliable source for global climate data.<sup>6</sup> Similar to the NCA, the IPCC concluded that "scientific evidence for warming of the climate system is unequivocal." In addition to their assessment reports, the IPCC releases other reports that were utilized in the compilation of this report and can be found in the reference section of this document.

In order to understand the story behind global climate change, it is imperative to begin with greenhouse gases. Greenhouse gases are gases that trap heat in the atmosphere—much as a greenhouse traps heat for the growth of plants. Examples of greenhouse gases include carbon dioxide (CO<sub>2</sub>), methane, nitrous oxide, and fluorinated gases with a breakdown of emissions in the US found to the right.<sup>7</sup> Because it makes up the largest share, CO<sub>2</sub> gets most of the attention, although the others cannot be entirely ignored because they are actually more potent trappers of heat, measured by Global Warming Potential (GWP).<sup>8</sup> It is important to note that greenhouse gases existed long before humans began exploiting the earth, and some smaller fluctuations may be expected due to natural events, however the massive increase that has been observed from the Industrial Revolution to the present are unprecedented and due to human activity. The figure below charts the level of CO<sub>2</sub> in the atmosphere over the long term history of the planet, and illuminates the huge, jump that has occurred over a relatively short time.<sup>9</sup>



As a result of the rising greenhouse, the global temperature has been rising in recent decades. The warming seems to be accelerating with nine of the ten warmest years on record occurring since 2005. The chart on the next page shows that past four years (2015-2018) have been the four warmest years ever recorded with the average surface temperature of the planet in 2018 at 1.42°F (0.9°C) above the 19th century average, based on National Oceanic and

Atmospheric Administration (NOAA) data.<sup>10</sup> While this may seem like a small amount, subsequent sections of this report outline the effects that are already being felt around the world and how experts project their impact to worsen in the future.

As the earth's surface temperature rises, so too does the temperature of the oceans. A report released in September of 2019 by the IPCC lays out the devastating effects that warming has had and will continue to have on ocean ecosystems, and communities who rely on them and live near them. Decades of evidence suggests that the ocean has absorbed 90% of the extra heat trapped by additional greenhouse gases and 20-30% of atmospheric  $CO_2$ . This has had an impact on marine life, especially coral reef ecosystems. Projections estimate that 99% of coral reefs could collapse if global temperatures rise by 2°C, and it is becoming increasingly apparent that that benchmark is very likely to be surpassed. In addition to harming marine life, warmer ocean temperatures increase the amount of moisture in the atmosphere, fueling stronger hurricanes and rainier storms.<sup>13</sup>



With both air and sea temperatures on the rise and forecasted to continue to do so, the planet's ice is in jeopardy. From mountain glaciers to polar ice caps, ice everywhere is changing and shrinking, impacting drinking water, agriculture, energy production, and sea levels. Additionally, the vast sheets of ice located at the earth's poles act as a kind of "air conditioning," so as we lose more and more ice the global temperature may begin to change at an even more rapid pace. As that happens, sea levels will continue to rise in a devastating way. Data shows that since the early 1900s, average sea levels around the world have risen by just over 6 inches. If the countries of the world are able to make significant reductions in greenhouse gas emissions and meet the goals of the Paris Climate Accord, this best-case result would yield a rise of nearly 16 inches by 2100. However, if we continue on our current path, oceans could rise by as much as 3.5 feet by 2100, causing massive coastal flooding and

economic devastation.<sup>12</sup> As outlined in the map and figure on the next page, the IPCC report

projects in both it's best-case (RCP2.6) and worst-case (RCP8.5) models that once-rare "100 year events" (such as devastating floods and storms) will occur on an annual basis in coastal cities around the world by the middle of the century.<sup>11</sup>

In general, WET areas will get WETTER and DRY areas will get DRIER.

An uptick in hurricanes and coastal flooding is not the only weather phenomenon that can be expected as a result of a warming climate.<sup>11</sup> As might be expected with a rising average global temperature, extreme heat events have been on the rise since the 1950's, with record high-temperature events on the rise and fewer cold nights. Climate change has begun to and will continue to affect global precipitation patterns. Effects will vary regionally, but scientists believe that generally wet areas will get wetter and dry areas will get drier. Even in areas where the overall annual precipitation isn't projected to change significantly, it is expected that the rain will come in more extreme events, leading to more flooding.<sup>3</sup>

# Extreme sea level events

Due to projected global mean sea level (GMSL) rise, local sea levels that historically occurred once per century (historical centennial events, HCEs) are projected to become at least annual events at most locations during the 21st century. The height of a HCE varies widely, and depending on the level of exposure can already cause severe impacts. Impacts can continue to increase with rising frequency of HCEs.



Finally, it is prudent to acknowledge that although projections are based on complex models that utilize data from thousands of studies spanning decades, there is still some uncertainty. For that reason, the IPCC runs multiple simulations under a variety of conditions and assumptions to illuminate the possible paths that we may follow. As referenced in both the map above and the one on the next page, the two most notable simulations are RCP2.6 (which assumes countries around the world are able to limit emissions and meet the targets of the Paris Climate Agreement) and RCP8.5 (which takes the approach that humans will continue along the current path and not make significant efforts to reduce greenhouse gases in the atmosphere). Additionally, these models assume that there will be no catastrophic events (such as a massive volcanic eruption or reaching a "tipping point" in melting of ice sheets) that could

speed warming and hasten the effects. The maps below compare the projections of the two simulations and their predictions for four different key indicators.<sup>14</sup>



# **Global Strategies**

<u>Key Takeaways:</u>

- Responses to climate change must include both adaptation and mitigation strategies.
- Key adaptation strategies include evolving agriculture to match the changing climate and environmental needs, as well as disaster-resistant development.
- Mitigation strategies include a reduction in carbon emissions through means such as renewable energy, reduced consumption, carbon capture, as well as government regulation.
- The 2015 Paris Climate Agreement was the largest, coordinated effort among world governments to address climate change.

The amount of greenhouse gases in the atmosphere is increasing, the global temperature is rising, and the effects of climate change are already being felt by communities around the globe. Greenhouse gases, such as carbon dioxide, linger in the atmosphere for tens, if not hundreds, of years meaning that even if we stopped emitting all greenhouse gases today the effects of past emissions would be felt for generations to come. As a result, we are already "committed" to a certain amount of climate change, which means that a viable response includes two aspects: mitigation and adaptation. Mitigation involves reducing the amount of heat-trapping gases in the atmosphere (i.e. reducing climate change), whereas adaptation is adjusting to actual or predicted climate change (i.e. adapting to life in a changing climate).<sup>15</sup>

When it comes to adaptation, even though climate change is a global issue, local communities are leading the way because they best understand the potential impacts.<sup>16</sup> This is not the first round of climate variation that civilizations have faced, but historically adaptation strategies involved relocating to a new, more habitable land. While that option might prove necessary in certain island and coastal regions, simply moving to more hospitable territory is not an option for the vast majority of people in the modern world. Today communities look to adapt by creating defenses against floods (walls, pumps, construction strategies, water-permeable pavements, etc.), adopting plans for extreme heat and drought, and implementing new agricultural or land management strategies.<sup>15</sup> Given that different locations will require different strategies, we will go into some of the adaptation ideas that may be helpful for Rosebud in a subsequent section.

As for mitigation, there are two ways to reduce the amount of heat-trapping gas in the atmosphere: emit less or sequester more. The most common solution for decreasing emissions is shifting from a fossil fuel-based economy to one that is powered by renewable energy

sources such as wind and solar. Nuclear energy and hydro-electricity also have lower emissions, but come with other ethical dilemmas and stigmas. Another way to reduce harmful emissions is simply to consume less through practices such as reducing driving, reusing goods, being more conscious of energy usage, and making environmentally-friendly food choices. While these individual actions may have a small effect, the collective action of millions of people can make a difference and impact government policies. Lessening the amount of greenhouse gases in the atmosphere can also be done through increased sequestration of those gases. This is done by enhancing the "sinks" (oceans, forests, and soil) that accumulate and store these gases.<sup>15</sup> In its simplest form, this idea is enacted by planting more trees—which convert CO<sub>2</sub> to oxygen and store additional carbon biomass in their trunks, roots, and leaves—but also includes afforestation, reforestation, and other conservation methods. Additionally, new technologies aimed at the capture and storage of carbon emissions are being developed and tested as part of a multi-pronged solution but are still very costly to implement.<sup>17</sup>

While much of the early action has been led by grassroots movements, it is imperative to have governments join the effort. Tighter environmental regulations—such as fuel efficiency standards, a carbon tax, and limitations around fossil fuel extraction—are also needed to incentivize large corporations to limit the harm they are doing to the planet. The 2015 Paris Climate Agreement was the largest, coordinated effort among world governments to address climate change. Each country made voluntary commitments to take actions to reduce their carbon footprint in an attempt to limit the temperature to 2°C above pre-industrial levels.<sup>38</sup> After becoming president, Donald Trump stated that the US does not intend to remain in the agreement, leading many Native American tribes and organizations to condemn the move and express their commitment to the agreement.<sup>39</sup>

Below is the IPCC's evaluation of various land management options, with the dark blue being the most impactful:

# Potential global contribution of response options to mitigation, adaptation, combating desertification and land degradation, and enhancing food security

**Panel A** shows response options that can be implemented without or with limited competition for land, including some that have the potential to reduce the demand for land. Co-benefits and adverse side effects are shown quantitatively based on the high end of the range of potentials assessed. Magnitudes of contributions are categorised using thresholds for positive or negative impacts. Letters within the cells indicate confidence in the magnitude of the impact relative to the thresholds used (see legend). Confidence in the direction of change is generally higher.

esp	oonse options based on land management	Mitigation	Adaptation	Desertification	Land Degradation	Food Security	Co
	Increased food productivity	L	М	L	М	Н	-
	Agro-forestry	М	М	М	М	L	۲
u	Improved cropland management	М	L	L	L	L	•
	Improved livestock management	M	L	L	L	L	۲
0	Agricultural diversification	L	L	L	м	L	
	Improved grazing land management	M	L.	L	L	Ĺ	-
	Integrated water management	L	L	L	L	L	6
	Reduced grassland conversion to cropland	L		L	L	- L	
	Forest management	М	L	L.	L L	L	
	Reduced deforestation and forest degradation	Н	L	L	L	L	
	Increased soil organic carbon content	н	L	М	М	L	
	Reduced soil erosion	←→ L	L	м	м	L	
	Reduced soil salinization	N <u></u>	L	L	L	L	
	Reduced soil compaction		L		L	L.	
	Fire management	м	М	м	м	L	
	Reduced landslides and natural hazards	L	L	L	L	L	-
	Reduced pollution including acidification	↔ M	М	L	L	L	-
	Restoration & reduced conversion of coastal wetlands	м	L	М	М	<u>الم</u>	-
	Restoration & reduced conversion of peatlands	М		na	M	- L	
sr	oonse options based on value chain managen	nent					-
	Reduced post-harvest losses	н	М	L	L	Н	-
	Dietary change	н		L	н	н	-
	Reduced food waste (consumer or retailer)	н		L	м	М	-
	Sustainable sourcing		L		L	L	
	Improved food processing and retailing	L	L			L	-
	Improved energy use in food systems	L	L	· · · · · · · · · · · · · · · · · · ·		L	-
sr	nonse ontions based on risk management				·		-
31	Livelihood diversification		L		L	1	
	Management of urban sprawl		1.5	1	M	1	-
8							

Options shown are those for which data are available to assess global potential for three or more land challenges. The magnitudes are assessed independently for each option and are not additive.

Key for criteria used to define magnitude of impact of each integrated response option

		Mitigation Gt CO2-eq yr <sup>-1</sup>	Adaptation Million people	Desertification Million km <sup>2</sup>	Land Degradation Million km <sup>2</sup>	Food Security Million people
	Large	More than 3	Positive for more than 25	Positive for more than 3	Positive for more than 3	Positive for more than 100
	Moderate	0.3 to 3	1 to 25	0.5 to 3	0.5 to 3	1 to 100
	Small	Less than 0.3	Less than 1	Less than 0.5	Less than 0.5	Less than 1
	Negligible	No effect	No effect	No effect	No effect	No effect
	Small	Less than -0.3	Less than 1	Less than 0.5	Less than 0.5	Less than 1
-	Moderate	-0.3 to -3	1 to 25	0.5 to 3	0.5 to 3	1 to 100
÷	Large	More than -3	Negative for more than 25	Negative for more than 3	Negative for more than 3	Negative for more than 100

#### Confidence level Indicates confidence in the

estimate of magnitude category. *H* High confidence

M Medium confidence

L Low confidence

#### Cost range

See technical caption for cost ranges in US\$ tCO2e<sup>-1</sup> or US\$ ha<sup>-1</sup>.

High cost
 Medium cost
 Low cost
 no data

# The Local Situation

<u>Key Takeaways:</u>

- Indigeneous groups are affected uniquely by climate change and are limited in their ability to respond.
- In South Dakota, average temperatures have risen 2°F since 1900 and are expected to increase more rapidly in the future with increases above 10°F possible by the end of the century.
- Precipitation is expected to become more unpredictable and volatile from year to year, leading to more extreme storms, droughts, and flooding.
- These events threaten an already vulnerable infrastructure and economy.

In order to create a strategic plan for the Rosebud Reservation, it is imperative that we zoom in and look at how climate change is projected to impact the Sicangu Oyate. The National Climate Assessment dedicates an entire chapter of their report to Tribes and Indigenous Peoples and concludes that "though they may be affected by climate change in ways that are similar to others in the United States, Indigenous peoples can also be affected uniquely and disproportionately." After highlighting the caveat that Native groups are diverse cultural and political entities which each face unique circumstances, the chapter focuses on three key messages pertaining to Native populations which are important to understanding the context of addressing climate change on the Rosebud Reservation<sup>2</sup>:

- "Climate change threatens Indigenous peoples' livelihoods and economies, including agriculture, hunting and gathering, fishing, forestry, energy, recreation, and tourism enterprises. Indigenous peoples' economies rely on but face institutional barriers to, their self-determined management of water, land, other natural resources, and infrastructure that will be impacted increasingly by changes in climate."
- 2) "Indigenous health is based on interconnected social and ecological systems that are being disrupted by a changing climate. As these changes continue, the health of individuals and communities will be uniquely challenged by climate impacts to lands, waters, foods, and other plant and animal species. These impacts threaten sites, practices, and relationships with cultural, spiritual, or ceremonial importance that are foundational to Indigenous peoples' cultural heritages, identities, and physical and mental health."
- 3) "Many Indigenous peoples have been proactively identifying and addressing climate impacts; however, institutional barriers exist in the United States that severely limit

their adaptive capacities. These barriers include limited access to traditional territory and resources and the limitations of existing policies, programs, and funding mechanisms in accounting for the unique conditions of Indigenous communities. Successful adaptation in Indigenous contexts relies on use of Indigenous knowledge, resilient and robust social systems and protocols, a commitment to principles of self-determination, and proactive efforts on the part of federal, state, and local governments to alleviate institutional barriers."

Although there is a unique cultural and jurisdictive landscape within the bounds of the Rosebud Reservation, many of the global effects of climate change highlighted above apply locally as well. Both the NCA report referenced above and NOAA's state summary for South Dakota and Nebraska project that temperatures will rise and precipitation patterns will change. Higher temperatures will lead to a loss of soil moisture leading to an increase in the intensity of naturally-occurring future droughts. Additionally, winter and spring precipitation is projected increase, as are to heavy precipitation events, which will raise the risk of flooding, particularly in the springtime.<sup>18,19</sup>

Historical data suggests that average temperatures in





Graphic from NCA4. Sources: NOAA NCEI and CICS-NC.

South Dakota have already risen by approximately 2°F since the beginning of the 20th century. In fact, recent decades have been warmer than any other period, aside from the Dust Bowl era of the 1930s which was a historic anomaly likely exacerbated by poor land management. The recent warming has been especially evident in the winter and spring, while summer temperatures have not deviated much from historical averages, something that is common across many states in the Great Plains and Midwest. Going forward, the temperature is projected to continue to rise but the magnitude of the change varies greatly depending on the impact of global mitigation strategies. Should global emissions be reduced and stabilized in the long run, forecasts estimate a temperature increase of between 2-10°F over the average from 1901–1960. However, if emissions continue to rise without interference the temperature increase jumps to a range of 6-16°F.<sup>18</sup>

Even though rising temperatures gets most of the attention when it comes to climate change, the unpredictability and volatility of precipitation will arguably be the most significant direct effect on the Rosebud Reservation, leading to extreme events such as droughts and floods.<sup>18</sup> The year-to-year variability of precipitation can be seen in the graph below, which shows the percent of the state of South Dakota that has been under drought conditions since 2000.<sup>20</sup> In years of low summer precipitation, the projected higher temperatures will be a compounding factor leading to lower soil moisture and increased intensity of droughts. At the same time, winter and spring precipitation are forecasted to increase, as are heavy precipitation events. This series of factors intermingle to create a higher probability of devastating floods that threaten the region's agriculture, economy, and infrastructure.<sup>18</sup>



Graphic from drought.gov. Sources: NDMC, USDA, NOAA.



Graphic from NOAA South Dakota State Summary Sources: CICS-NC and NOAA NCEI



# The Local Impact

<u>Key Takeaways:</u>

- Experts predict there will be mass migrations in the US in coming decades, but that the effects to Rosebud will be more regional than local.
- The overall economic impact of climate change is projected to be slightly negative for Rosebud.
- Agriculture may see a short-term boom, but over the long term output will likely decrease.
- Infrastructure and public health will be threatened by climate change.
- The cultural impacts are unknown locally and should be studied further.

While forecasts project that the local climate will change in the coming years, there is not expected to be mass migration or economic devastation in the area. As the map below shows, cities like Miami, New Orleans, and San Francisco may experience large population drops, but the vast majority of those people are expected to relocate to inland cities. Overall, the general trend is expected to be more people moving away from rural areas into cities, meaning the population trends of the Rosebud Reservation are expected to remain unchanged through the end of the century. However, places like the Black Hills, Pierre, Sioux Falls, and Omaha are expected to experience population growth which would increase demand for water, food, electricity, and other goods.<sup>37</sup>



A separate projection examined the economic impact that global warming is expected to have through the end of the century based on six key factors: agriculture, crime, health, energy demand, labor, and coastal communities. Looking at 29,000 simulations of the US economy, they project that the economic output of the Rosebud region will be negatively affected by 0-5%. Agricultural output and crime (crime rates tend to rise with the temperature) were two factors that lead to this conclusion. It's important to note that Rosebud is close to the north-south "cut off" at which the effects of climate change begin to boost the economy, which emphasizes the importance of proper adaptive measures, especially in agriculture. Also, researchers in both studies pointed out that predicting human behavior is extremely difficult, particularly "under such extreme and historically unprecedented circumstances."<sup>36</sup>



The predicted drop in economic output is largely due to the fact that local agriculture has the potential to be significantly impacted by the effects of climate change in a variety of ways. The high variability of rainfall, accompanied by a rise in the number of high precipitation events could make the water distribution necessary for growing crops a challenge. The 10-30% increase in winter and spring precipitation that is predicted will help by increasing available soil moisture but also has the negative effects of loss of soil nutrients and potentially delaying or preventing planting, resulting in loss of yield. A higher number of heavy precipitation events would lead to increase in damage potential from hail is predicted under the scenario of continued high emissions, while an increase in weeds, invasive species, and crop pests is also

expected. On top of that, higher temperatures are expected to increase evaporation and offset any increase in precipitation, leading to more frequent and more severe droughts. Lastly, the forecasted increase in excessive heat days brings added danger to livestock and agricultural laborers who work outside in the elements.<sup>1</sup>

Despite the possibility of long-term negative impacts, climate change may actually be a short-term boon to the agricultural economy. First, rising temperatures mean that the growing season may be extended, a fact that is already being observed and is expected to continue over the next 20-30 years. Additionally, one positive aspect of high CO<sub>2</sub> concentrations is stimulated plant growth and an increase in plant water-use efficiency (though not enough to overcome drought conditions).<sup>1</sup> If the short term gains are to translate to the long run, responsible agricultural techniques are imperative. Research has shown that the recent conversion of land from conservation land to cropland may actually compound the regional effects of climate change.<sup>22</sup> Agricultural adaptation will be most effective when biophysical, social, and economic components are integrated into the decision making process. Science-management partnerships also offer the opportunity to increase knowledge of adaptive techniques and spread information to producers. A number of "early-adopters" have already implemented innovative techniques that aim to balance economic and environmental goals, so learning from their experience should be part of the agricultural process moving forward.<sup>1</sup>

Infrastructure, public health, and disaster management will also be faced with unprecedented challenges. Systems such as communication, transportation, water, and sanitary infrastructure are open to disruption everywhere, but the vulnerability in poor, rural areas is especially high.<sup>23</sup> Tribes are faced with the added layer of a bureaucratic reporting process that is required of tribes for many improvement projects. Additionally, funding limitations brought about by a lack of federal support, low tax revenues, and limited economic opportunity result in underdeveloped, deteriorating infrastructure on reservations.<sup>2</sup> In 2019, both Yankton and Pine Ridge suffered historic flooding in what may be an event that foreshadows what is to come. In Pine Ridge, a spring blizzard blanketed the area in snow, blocking access to many poorly maintained rural roads and knocking out power for some. Over the next few days, the temperature rose dramatically and melting snow created devastating flooding leaving many residents stranded and cut off the water supply to about 8,000 people. The storm was blamed for four deaths and required emergency assistance from the state and federal government.<sup>24</sup> Yankton was hit with floodwaters from the same storm, and six months later was still in a dire situation. After additional heavy rains fell, septic systems to backed, mold grew, and standing water remained, threatening the water supply and causing waterborne illness.<sup>25</sup>

Also of significance is the threat to the infrastructure associated with the extraction, distribution, and production of fossil fuels. For example, railroads and pipelines that are used to transport fossil fuels are susceptible to damage or disruption from flooding or erosion that would be the byproduct of an increase in heavy precipitation events. A leak or spill could cause extensive environmental damage, contaminate water sources, and endanger sacred sites. Summer heatwaves have also been shown to damage railroad tracks and are expected to reduce the efficiency of transmission lines. Additionally, tribes in the Northern Great Plains are experiencing more frequent and intense fires which also pose a risk to energy infrastructure.<sup>1</sup>

Pipelines are not the only threat to the water supply. As flooding increases, so does runoff from agricultural areas. This can have a number of effects on local water supply including contamination due to animal waste and the introduction of other fertilizers and pesticides used by farmers. These high-nitrate pollutants can create toxic algae blooms in lakes and ponds that impact the well-being of local fish, birds, and other animals.<sup>25</sup>

In addition to the agricultural and economic impacts that climate change is expected to have on the region, there may be cultural impacts as well. Extreme heat, droughts, floods, and fires may cause certain traditional plants and medicines to decline across the region. Additionally, climate change is likely to lead to an increase in invasive species, creating yet another threat to indigenous plants. Although it has not been documented locally, these effects have already been noted by regional tribes, such as the Crow who have seen a disruption in their ability to harvest cottonwood and willow trees for ceremonial purposes and report having greater difficulty gathering traditional foods such as chokecherries and buffalo berries. Additionally, elders and young children are most vulnerable to expected uptick in extreme heat, and those heatwaves could also impact the participants in summer ceremonies or influence who chooses to participate.<sup>1</sup>

Despite the variability in the modeling and impossibility of knowing exactly how humanity will react to the threat of climate change in coming decades, it is useful to imagine a potential timeline of realistic events to fully understand the magnitude and urgency of the situation. Below is one such timeline, overlayed on the temperature projection graphic from NOAA's South Dakota State Summary (the full graphic can be found in "The Local Situation" section of this report).



# <u>Water</u>

<u>Key Takeaways:</u>

- Overall, the volume of surface water and groundwater supplies are expected to remain steady or increase slightly.
- A growing population in urban areas of South Dakota and Nebraska along with limited access to water in other areas of the country could increase demand on the water supply of the Sicangu people.
- More extreme storms and flooding increase the vulnerability of pipelines (both oil and water) which threatens the local water supply.
- Many areas of the economy and daily life would be affected by water cutoff or contamination.
- Securing water rights is an urgent issue facing the Rosebud Sioux Tribe and a threat to the tribe's sovereignty.

Encapsulated by the phrase "Mni Wiconi," water is a vital aspect of Lakota life, spirituality, and the economy. A disruption in the water supply would have widespread impacts on public health, agriculture, hunting and gathering, fishing, forestry, energy, recreation, and ceremonies. This section summarizes the projected effects of climate change on the local water supply and what can be done to protect it.

Despite the volatility in precipitation outlined in The Local Impact section, neither surface water nor groundwater supplies are expected to be threatened by climate change. In recent years, red flags have been raised about the drying out of the Ogallala Aquifer, but the map below shows that the northern region of the aquifer is maintaining or even increasing its



capacitv<sup>18</sup> (with additional upticks after likely the historic precipitation across South Dakota and Nebraska in 2019 that are not included in the map). The NCA concludes that "groundwater and aquifer recharge rates

Graphic from NCA4. Source: adapted from McGuire 2017

are relatively high in the region and seem sustainable given current rates of groundwater extraction" but also notes that population growth or alteration of agriculture practices will increase dependence on reservoir capacity and infrastructure integrity. Similarly, average streamflow is projected to increase slightly.<sup>1</sup>

While climate scientists don't project the volume of the water supply available to the Rosebud Sioux Tribe to decrease, there could be other outside threats. The first threat comes in the form of pipelines. Even under normal weather circumstances pipelines can leak, and the predicted increase in extreme storms and flooding only heightens that risk. Both the Missouri River and the Ogallala Aquifer are potentially at risk of contamination. Another infrastructure risk is damage to another type of pipeline: water pipelines -- such as those that deliver clean water to over 50,000 people as part of the Mni Wiconi Rural Water System. Mni Wiconi pipelines are equally vulnerable to damage by storms and flooding and a disruption to their distribution could be devastating for the Rosebud area.



Additionally, outside demand could threaten the water supply of the Sicangu Oyate. As a result of weather changes and coastal flooding, millions of people could be forced to relocate. While experts don't believe there will be a mass migration onto tribal lands, nearby areas such as the Black Hills, Pierre, Sioux Falls, and Omaha are expected to see noticeable growth. With that growth comes higher demand for water, which could increase costs or disrupt the waterways that local people rely on. On top of that, growth and development increase the risk of water pollution and contamination. A look at the current situation in the American Southwest—where disputes that lead to long, expensive court battles are erupting constantly—could provide a glimpse at the future of water rights and disputes in the region.

In order to protect against the outside threats of pipelines, increased demand, and legal disputes, it is imperative that the Rosebud Sioux Tribe develops a plan to quantify and secure

water rights for the Sicangu Oyate. This process is not to be taken lightly, as it is an expensive, detail-oriented, and lengthy process with the federal (and sometimes state) government. Tribes must create a proposal that then goes to the executive branch of the US government to decide on a settlement. Despite the risk of denial and upfront cost, securing water rights has been shown to have a positive impact on reservation economies and is a necessary step in a truly sovereign adaptation strategy that addresses cultural, municipal, recreational, agricultural, and fishing needs.

An important part of the battle over water security will be the ability to quantify the impact of outside threats. One possible way to analyze the effects of a growing regional population and/or water contamination is through a Computable general equilibrium (CGE) model. While a complete analysis has not been done for Rosebud, a process similar to the one followed by Yankton to quantify the effects of a spill of the Dakota Access Pipeline could be performed. This analysis takes a multi-faceted approach to attempt to do the impossible—assign a dollar value to the damages caused by contamination. This type of defense has been used in court cases in the past and ensuring that resources are available to perform the proper analysis when the time comes will be vital to protecting the water supply of the Sicangu Oyate.

# Local Challenges and Opportunities

<u>Key Takeaways:</u>

- Despite being a sovereign nation, the Rosebud Sioux Tribe will face legal, jurisdictional, and regulatory hurdles when taking action on climate change.
- Quantifying and securing water rights is a long and expensive process but has been linked to positive economic outcomes.
- Lack of disaster preparedness and emergency response planning present a threat to tribal citizens and the tribal economy.
- The Rosebud Reservation has enormous wind and solar energy potential.
- High unemployment means there is a large supply of workers to fill renewable energy jobs, if provided the right training.

As a sovereign nation, the Sicangu Oyate or Rosebud Sioux Tribe is faced with a unique set of challenges and opportunities. On one hand, self-determination theoretically provides tribes with the authority to develop and implement their own climate change mitigation and adaptation policies. However, the legal and regulatory barriers that exist as a result of post-colonial resettlement, land fragmentation, and uneven regulation by federal agencies. One example is the trust relationship that exists with the federal government, which means that the federal government holds the titles of tribal lands "in trust" and maintains the ultimate say in many aspects of land and resource management. Another recognized obstacle to economic self-determination and climate adaptation for tribes has to do with water rights. In order to quantify and secure water rights, tribes must go through an expensive and lengthy process with the federal (and sometimes state) government, and even upon completing a proposal are at the whim of the executive branch of the US government and not guaranteed a settlement. Although the water supply in the Rosebud region is not predicted to drop in the coming decades, the threat of pipelines in the region could threaten the water supply, as could potential encroachment of people from other regions where water will become more scarce. Given those threats, securing water rights is a necessary step in a truly sovereign adaptation strategy that secures water for cultural, municipal, recreational, agricultural, and fishing purposes.<sup>2</sup>

Disaster management and emergency response is another potential threat to the Sicangu Oyate that is magnified by climate change. Over the last two decades, tribes in the Northern Great Plains have been affected by unusually catastrophic fires, floods, and droughts that push the limits of emergency responders. In fact, since 2012 the Rosebud Reservation has been impacted by each of these categories of natural disasters, but fortunately has avoided catastrophic conditions. As mentioned earlier, other nearby reservations have not been so lucky, which demonstrates the urgent need to have climate adaptation plans in place. Unfortunately, the historical underfunding and lack of resources make that a challenge.

Over the next few decades, climate change is likely to boost agricultural potential in the area. With a land base of nearly 1,000,000 acres, the tribe is uniquely positioned to develop a strategic, sustainable strategy to increase agriculture among tribal citizens and boost the local economy. Expanding and replicating community enterprises like the REDCO Food Sovereignty Initiative creates the added benefits of food security, access to healthy food options, and lowering carbon emissions by eliminating the need for food transportation.

Another opportunity lies in the potential for renewable energy like wind and solar. At one time the Rosebud Sioux Tribe was considered a leader in renewable energy when the Alex Little Soldier wind turbine (located near the Rosebud Casino) became the first tribally-owned large scale wind turbine in the country.<sup>26</sup> Given the tribe's significant land base and the wind<sup>27</sup>



and solar<sup>28</sup> energy potential illustrated in the graphs above, the tribe has the ability to achieve energy independence and once again become a leader in the field, creating jobs and lowering emissions in the process.

The current economic state of the Rosebud Reservation presents both opportunities and challenges for implementing climate adaptation and mitigation measures. On one hand, the high unemployment rate means that there are plenty of local residents who are available to take on the work involved in new projects. However, high rates of poverty have also created a system in which Rosebud citizens face many barriers that make holding a steady job difficult, including but not limited to: lack of housing or transportation, health concerns, family responsibilities, mental addiction, low illness and educational attainment, and lack of experience.

# Local Strategies

<u>Key Takeaways:</u>

- Securing water rights is an urgent issue facing the Rosebud Sioux Tribe and a threat to the Tribe's sovereignty which must be addressed.
- In order to avoid desertification and loss of soil nutrients, responsible land conservation policies must be enacted locally and lobbied for state-wide.
- An already-deteriorating infrastructure (unpaved and unmaintained roads) must be addressed before a catastrophic event endangers lives and the economy.
- The tribe should adopt an emergency response plan for various natural disasters that threaten the Sicangu Oyate.
- Renewable energy and microgrids must be urgently pursued to both combat carbon emissions and promote energy sovereignty.
- Improving public transportation, education, and tribal programs can educate tribal citizens on being better stewards for Unci Maka

The climate is changing and the Rosebud Sioux Tribe will face additional challenges as well as opportunities as a result of evolving conditions. In order to reduce the risks associated with rising temperatures and high variability in rainfall events, while at the same time working to mitigate the environmental harm the strategies below should be considered. This is not an exhaustive list, nor is it meant to be considered a blueprint to guaranteed outcomes; the list is simply meant to be a starting point for brainstorming potential solutions. For a more complete list of efforts that have already been enacted by tribes within the United States, please reference this BIA map: <u>https://biamaps.doi.gov/nca/</u>

# Adaptation:

 Land management - The IPCC points out that "Many land-related responses that contribute to climate change adaptation and mitigation can also combat desertification and land degradation and enhance food security." The practices that it found to have the highest efficacy are sustainable food production, agroforestry, improved and sustainable forest management, soil organic carbon management, ecosystem conservation and land restoration, reduced deforestation and degradation, and reduced food loss and waste.<sup>29</sup> A panel that evaluates a number of land management policies' impact and efficacy can be found on page 15.

- Securing Water Rights Although the process of reaching a water rights settlement is long, complicated, and expensive, water rights settlements have been shown to have a positive impact on reservation economies and are a necessary step in water security. Additionally, by continuing to fight the Keystone XL pipeline and other external threats to the water supply, the tribe will be working toward this goal.
- Disaster Mitigation/Emergency Response Plan As evidenced by recent events in Pine Ridge and Yankton, tribal communities in South Dakota are at risk of the effects of climate change. State and federal support are not always timely or reliable, so it is important to have an emergency response plan in place in the event of a fire, flooding, drought, or other natural disaster. FEMA provides resources specific to climate change<sup>33</sup> as does the American Planning Association<sup>34</sup>. Poor road maintenance and conditions should be addressed, and given that pipelines and flooding pose potential threats to the water supply, water storage and security should also be considered in an emergency plan.

## Mitigation:

- Renewable energy production As mentioned earlier, the Rosebud Reservation has enormous wind and solar energy potential. When considering renewable energy, upfront costs must be considered, as well as ongoing maintenance costs and the expertise required to perform upkeep. Several schools in South Dakota offer programs related to renewable energy and some are eligible for the Build Dakota Scholarship which ensures students graduate without debt.<sup>30</sup> Other programs like SolarCorps offer a yearlong, paid fellowship in which participants receive training in solar installation and management.<sup>31</sup> By coupling this project with a localized "microgrid" (a smaller version of the electrical grid that powers the entire country) the tribe would ensure energy sovereignty and avoid the threat of power interruptions from outside sources.<sup>32</sup> Adopting wind and solar energy has the added benefit of creating new high-demand jobs that do not necessarily require a four-year college degree.
- Recycling and Composting Program Recycling and composting are two ways to reduce greenhouse gas emissions with relatively little investment and impacts that take effect right away. For example, making a new aluminum can from a recycled can results in 90-97% energy savings. Additionally, when tossed in a landfill, food waste creates methane, but when it is composted it actually sequesters carbon and enriches the soil, among other benefits.
- Improved Public Transportation In addition to the public health and social benefits, a robust transportation system would reduce carbon emissions.

- Public Education Campaign With little to no cost, tribal leadership could enact a public service campaign to educate the public on reducing their carbon footprint. The campaign could encourage residents to drive less or carpool, recycle and compost, reduce electricity use, use land and natural resources wisely, and make eco-friendly food choices, such as eating less meat, planting a garden, and eating local.
- Resolution or Public Commitment to Reducing Carbon Footprint The Rosebud Sioux Tribal Council created a workgroup in September of 2019 which is focused on addressing climate change. This is a great first step to centralize initiatives and grant-writing for both adaptation and mitigation efforts.

Impact	Solution
Rising temperatures	<ul> <li>Adaptive and regenerative agriculture</li> <li>Research-based land management practices</li> <li>Low emission renewable energy</li> </ul>
High variability precipitation	<ul> <li>Water management and storage</li> <li>Forest management to lower wildfire risk</li> <li>Drought resistant crops</li> </ul>
Increase in extreme storms	<ul> <li>Resilient construction</li> <li>Disaster management and response plan</li> </ul>
Higher flooding risk	<ul> <li>Investment in roads and infrastructure</li> <li>Development of emergency response plan</li> <li>Securing water rights to protect against pipelines and other contaminants</li> </ul>
Lower soil quality	<ul> <li>Regenerative land management techniques</li> <li>Adaptive agriculture practices</li> <li>Composting program</li> </ul>
Growing regional population	<ul> <li>Quantify and secure water rights</li> <li>Water storage plan</li> <li>Food sovereignty</li> <li>Energy sovereignty</li> </ul>
Disruptions in food supply due to weather	<ul> <li>Locally grown food</li> <li>Agricultural diversification</li> </ul>

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