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Iceland, Climate Volatility

Iceland: A Prevention for the Loss of Vegetation

Iceland is a nordic island in the North Atlantic Ocean and is roughly the size of Kentucky. Even though they are the same size, Iceland has a much smaller population. With its small population, it can be shocking to learn that Iceland has been a major tourist destination for its natural beauty. However, many tourists don't know that Iceland has been fighting many environmental problems. The country has been facing wind erosion and desertification from heavy winds and loose soil and has been struggling to fight it since 1907.

Iceland's government, according to the *Government of Iceland*, is a constitutional republic with a multi-party system. This means the head of state is a president, and right now the president is Guðni Th. Jóhannesson. Iceland is an open country meaning it has lots of land with few houses and has a population of 341,818. For comparison, Kentucky's population is 4.468 million. Even with its small population, Iceland is 6.145% rural and 94% urban (Climate Change Post). With a small population, one would think most of its land is used for farms, yet only $\frac{1}{5}$ of Iceland's total land area is suitable for livestock or food production, and of that, only 6% is cultivated. That means less than 2% of land is actually farmed (Climate Change Post). Climate Change Post adds how the major crops grown on these farms are hay, potatoes, root vegetables, barley, and oats. Also, with Iceland being an island, fish products are 76% of exports, with agriculture only accounting for 2% of their GDP. GDP, also known as Gross Domestic Product, according to *Investopedia* is the "total monetary or market value of all the finished goods and services produced within a country's borders in a specific time period," (Fernando). In simpler words, the GDP can gauge a country's economic health.

Even with the little cultivated land, many families live on a farm. Their farm normally contains around 30 dairy cows, 60 cattle, and 165 sheep in the winter with over 400 sheep in the summer. For context, the average farm in Ohio has 119 dairy cows, 17 cattle, and 35 sheep (*Farmers Weekly*). Most families in Iceland have a second job besides farming as the average temperature during the winter months is 14-32° F and farming is not as productive as it is in the summer. Even with their cold winters, Iceland gets hot air from the Gulf Stream and can have temperate climates. The geography of Iceland is mostly hills, mountains, fields, hot springs, and areas with lava. The average house has a washer and dryer along with heating and cooling; the heating is normally from a hot spring! The average family in Iceland has access to clean water in their house and almost all of the houses have an indoor toilet, electricity, telephones, and a working stove. Each house typically has a greenhouse where they grow fruits and vegetables. The average diet consists of seafood, cheese, skyr (yogurt), fish, lamb, and hangikjöt (smoked mutton). There isn't a barrier when it comes to nutrition as most of the food is grown or harvested on their farm. While the children help out their family at home, they also attend school. The education system in Iceland contains four levels, or schools, of education; Playschool, Compulsory, upper secondary, and higher. Education is mandatory for ages 6-16. All public colleges in Iceland are free and have no tuition fees. Iceland's universal healthcare is paid mostly by taxes (85%) and service fees (15%). The government, administered by Iceland's Ministry of Welfare, spends a lot of money on healthcare costs; spending \$6,086 in 2017 (Macrotrends). To connect all the houses there are roads, a majority being gravel and dirt. The main road, connecting a majority of stores, is called Ring Road which totals around 821 miles long.

While traveling along Ring Road, signs warning of the violent wind can be found. This wind is causing one of the problems that Iceland has been facing for many years, also known as Climate Volatility. Climate Volatility is when there is a significant change in the climate causing an adaptation in their agriculture practices or the creation of new policies. In Iceland, there is mild to serious wind erosion and desertification that results in a lack of vegetation. The erosion in Iceland is caused by winds that can have speeds ranging from 10 mph to even 70 mph (Campervan Reykjavik). These strong winds not only

affect vegetation but also have caused a loss in biodiversity and a disruption in the distribution of soil organic carbon. One reason erosion is so common is that highly erodible Andosols is typical on the ground in the highlands. Luckily, scientists have used tephrochronology dating (using volcanic material to do chronologic dating) to find what vegetation used to be present before eroding. In 1894, Iceland's first legislation was passed to help this issue. Unfortunately, this legislation was not helpful or effective so in 1907, the Forestry and Protection Against Soil Erosion Act led to the establishment of forest and soil conservation programs; some of which are still in use today. Another way they are trying to help prevent erosion is with the SCSI (Soil Conservation Service of Iceland) which works on controlling desertification and sand encroachment. Sand encroachment and desertification can be caused by katabatic winds (intense high-density winds that flow downward in high elevation areas). Since Iceland is on the edge of the Arctic Circle, they not only get the wind but also arctic storms. Iceland lies in the path of the North Atlantic Current and also the Irminger Current which moderates Iceland's temperature. Iceland is also loaded with volcanoes. This negatively affects the progress that programs make with desertification and soil conservation because when the volcanoes erupt they cover surrounding vegetation in a layer of dust which can disrupt their roots. The roots become unable to hold the vegetation in strong winds and the soil is now susceptible to wind erosion and the dust can be easily picked up causing dust storms.

This problem affects both rural and urban populations as strong winds can affect both vegetation and people. First, wind erosion can lower the food supply available to all people, as it hurts the crops. Also, strong winds can make it hard for people, in both areas, to drive or even walk outside. This may also cause a problem for the old or young, as the wind can lower the temperature in the area. The soil picked up from the wind can also affect the air quality which can affect those with respiratory issues. This topic of wind erosion and desertification can affect marginalized people as they might not have a house that will withstand the wind; however, they might not have a farm which then would mean they don't have to worry about a loss of vegetation. If they do have a farm, it can make it hard if they were to try and start to grow crops after a loss from wind erosion. Farmers might not have the materials or money to replant them. This can then affect their food supply. This problem has increased because Iceland has been cutting down trees for materials and room for farms. Not only does this hurt the environment but it removes homes for animals. This can affect the biodiversity and success of animals living in that area. With the trees cut down, when strong winds occur, the soil gets picked up without the roots of the trees helping to hold the soil. The wind also makes it hard for vegetation to grow and the land becomes less fertile as it dries out with the wind, unable to hold water.

One solution to this ongoing problem is to replant trees. Iceland's problem has been aggravated by removing the trees. Replanting them would help control the problem at the root (figuratively and literally). The Soil Conservation Service of Iceland was made over 100 years ago and is still in use today doing things like seeding grass to help stop soil erosion and adding fertilizers to increase the amount of vegetation. While they are working to stop many projects at once, they have provided some solutions such as using a flower, the Alaskan Lupine, to try and control soil erosion. The Alaskan Lupine is used to fertilize the soil for future plants. The Lupine puts nitrogen (which is a nutrient that is lacking when erosion occurs) back in the soil. That being said, the Lupine does grow past where it was planted and the overgrown flower can hurt the growth and success of other plants.

One way to incorporate my solution is increased government funding to plant more trees and Alaskan Lupines. Not only would this provide many benefits to the environment but also the people living there. The solution to plant trees both near the farms and in open fields is a term called agroforestry. One strength is that the roots of the tree will help hold the soil together. In return, less soil will get picked up by the wind. The roots can help strengthen the soil and also can provide more protection to the plants. Another reason is that the trees will limit the amount of wind plants are getting. If we plant the trees in front of the crops, less wind will go on the crops and the crops will have time to grow. Trees will also help the people as planting trees can help produce more oxygen while removing CO₂ from the air, helping the atmosphere and air quality. Trees can also be low maintenance. Depending on the type of tree, they can require little work after being planted. The trees would not be hard to maintain and trees typically live a long life; they would not need to be replaced very often.

There are some negatives to this solution that must be considered. In order to block wind from all directions, trees would need to be planted on all sides. This can be expensive and if it is coming from the government, they might not be open to spending the money. If it came from taxes, those living there might not be open to the situation as they don't want to use their own money. The solution would need to be a compromise in terms of money to make the people and the government happy. Another thing to take into consideration is that these trees will be planted when they are small. It would take a long time for the trees to grow big enough to actually stop the wind and make a difference with the vegetation. Before the trees can even grow, they could be harmed by the wind which in return, would prevent their growth taking us back to where we started. Lastly, not all trees can withstand the wind and cold. The best type of tree would be an Evergreen tree. This tree keeps its leaves and stays green all year, hence the name "ever-green." One common tree in Iceland is the Sitka Spruce, a type of Evergreen.

If the government approves of the solution and gives funding, then everyone could pitch in to plant the trees. If they use slightly grown trees, rather than seeds, the trees would be able to block the wind while it is growing, helping provide a solution faster. The media can also help spread the word to help get trees planted. Everyone could then plant trees around their farm and also close to vegetation that is nearby them. This would not only help their crops but could also bring the community closer together as a whole. Another way to get people involved in the project is by providing a tax break to those who help. By rewarding people who help plant the trees, more people will be incentivized to plant the trees and more will get done. These trees would need time to grow, but wouldn't require much work once they grow. While they are growing, organizations can help water them and take care of them. One way to raise money if the government refuses is to accept donations or ask for help outside of Iceland. In the rare case that Iceland asks for help, many might be eager to help as Iceland is a wealthy country and could pay or help out the country later on. There have been times when places ask for help outside and communities and countries provide support. The community can also help get the word out, bring awareness, and they can help plant the trees. This could be a good project for kids, as it is not only something that gets them outside, but could be incorporated in schools if they made planting trees a part of their learning. They could teach how to take care of the trees and how the trees are helping. There would need to be policies in place to help keep this solution working. I think that it is important to approve where the trees are planted along with some restrictions so that trees aren't in spaces where they aren't needed especially if the number of seeds they have available is low or limited. The trees should be planted where they can help the vegetation and help reduce the amount of wind that is hurting the plants or causing erosion/ dust storms.

I am not sure if any cultural norms need to be considered when planting trees. Some people might refuse to plant trees because they don't have the time, but I don't think it would be for cultural reasons. One thing to consider is people might refuse to plant trees on their own farms due to personal reasons or traditions. One social norm is that people might want their farm to look nice and planting trees that will soon take up space, might be a problem for people who are trying to utilize and use all the space they have. Also, fewer crops then results in less money someone will make. There could be an issue with farmers not wanting to waste space for crops (that would make them money) with trees that wouldn't be able to be sold or eaten. While not everyone will be on board with the project, it will be sustainable. While it does cost lots of money and time to plant the trees, it also provides benefits. These trees will help clean the air by providing free oxygen into the atmosphere and will also help protect vegetation from wind erosion, dust storms and prevent desertification.

Overall, Iceland has been doing things to reduce wind erosion and damage. Some of these solutions have worked but the problem is still present and won't be solved overnight. With the addition of new ideas, we can help speed up the recovery of soil and vegetation. While planting trees won't solve all the problems, it can help reduce the trouble and has benefits that will not only help the environment but the people as well.

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