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Russia, Sustainable Agriculture

Siberian Russia : Greenhouse Agriculture for Cold Climates

People find ways to survive everywhere on the planet through their ingenuity and resilience to unfavorable environmental conditions, but this kind of life is by no means easy. Being so isolated from other groups of people can put a strain on food security, and while food can be hunted for in the arctic tundra of Russia, a balanced diet is made difficult due to permafrost restricting vegetation. While agriculture in countries or areas of countries with extremely cold and harsh climates has historically been restricted to growing only hardy crops, such as cabbage, that can survive frosts and colder weather in the past, now with today's technology it could be possible to grow any crop at any time during the year AND have no carbon emissions while doing it through the use of new greenhouse technologies.

The lack of variety in a diet can have negative effects on the body, especially over time, where long term health issues could possibly take place. Undernutrition is defined as "an insufficient provision of energy and nutrients, such as good quality protein with an adequate balance of essential amino acids, vitamins and minerals, and an inability to meet the requirements of the body to ensure growth, maintenance, and specific functions"(Martins). Especially in the cold climate of northern Russia, your body needs lots of calories to keep warm. A person can only survive without food for three weeks (Spector), but something that can be as damaging as a lack of food is the lack of variety in your diet. The body requires certain amounts of vitamins to function properly and stay healthy, and with the unique weather situation in northern reaches of Russia there is more of a chance of deficiencies such as with vitamin D. Problems such as these could be offset by diet. Siberians that live in the more southern parts of the region have just as much access to foods and medicines as anyone else in the world along their latitudinal lines, but these commodities are harder to transport and are less available going north, so those people will struggle the most with these health problems, especially if they are growing their own food. Though agriculture certainly does take place and can be successful, greenhouse agriculture could cause small amounts of land at a time to reach a peak crop yield, and be far more sustainable and efficient than farming in the permafrost alone.

As the 9th most populated country in the world and the one with the largest land mass, there's a lot going on in Russia, and while the life satisfaction may be below average (at a 6/10 as opposed to a 6.5), the people there are privy to all the benefits of a modern world (Agostini) and they have a moderate life expectancy of 71.3 years (Central Intelligence Agency). According to the Central Intelligence Agency's World Fact-book, of people living in rural areas of Russia, 91.2% of them have access to an improved water source ("use of…piped water into dwelling, yard, or plot; public tap or standpipe; protected dug well; protected spring; rainwater collection, etc") while the other 8.8% of rural population have access to an unimproved water source ("unprotected dug well; unprotected spring; cart with small tank or drum; tanker truck; surface water; or bottled water." (Central Intelligence Agency)). One hundred percent of the population also has access to sanitation facilities, either improved or unimproved, as well as to electricity, and 76.4% of people use the internet.

In an area as huge as Siberia, there is going to be diversity in the quality and methods of life found throughout. "Population is heavily concentrated in the westernmost fifth of the country extending from

the Baltic Sea, south to the Caspian Sea, and eastward parallel to the Kazakh border; elsewhere, sizeable pockets are isolated and generally found in the south" (Central Intelligence Agency). The city of Novosibirsk is the most populous in Siberia and the third most populous in all of Russia with ~1,511,000 people (Novosibirsk mayor's office). It has continental weather and operates similarly to any other large city in the world with a wide array of employment options and access to modern conveniences. Norilsk, on the other hand, is the northernmost city in the world located above the Arctic Circle with a permanent population of 175,000 people and is covered with snow for about 270 days a year. The city is industrial, "housing the largest nickel, copper, and palladium deposits in the world with more than 1.8 billion tons of resources", and there are significant coal, cobalt, and platinum mines there as well (Miklós). Unfortunately the city is extremely polluted, and any resources transported to them would add up to cause significant amounts of carbon emissions. Though these cities and others like them will have enough resources to sustain them whether the practices to procure and transport them are sustainable or not, the places that will struggle more with food security are smaller settlements scattered throughout the region.

Siberia consists of 5 million square miles of what seems to be nothingness with towns and lone settlements (Dash). There has even been a story of a family getting lost and living but barely surviving for as many as 40 years before they were rediscovered (Dash). Smaller settlements in northern Siberia will be based on more traditional systems of life with people growing their own food as well as hunting and gathering. This way of life can be very isolated and accessible only by snowmobile, helicopter, or vehicles traveling along a specially prepared winter road (Conant). If a farm only produces enough for its maintainers to eat, they won't have any surplus money to buy more nutritious foods or vitamin supplements to stay healthy. Siberians have the reputation of being extremely hardy because of the harsh environment they call home, and an inconvenience to their lifestyle is food supply. With the stress of staying alive in arctic conditions, large amounts of heavy food can be consumed and a person could still lose weight just because the calories are used up surviving the cold. Indigenous Siberian diets have traditionally been based on meat and fish (Ermolenko) but now include yields from plants and animals on farms. Living far off from other people with no sustainable way to grow adequate amounts of food for much of the year means that food and supplies would have to be transported to the village, but that food would come with a high price, as well as cause high carbon emissions from the vehicles used to transport them. Families that live in places like Siberia could benefit greatly from sustainable agriculture methods capable of handling the cold climate that would result in their becoming more self sustainable with a diverse and healthy diet. Another benefit is that the environment would not be greatly affected. Siberia is, after all, one of the great wildernesses on the planet, and should be preserved, and greenhouses would be constructed on a small scale and would be unreachable by wildlife, a well as potentially having zero emissions.

As previously stated, a solution to the nutrition, food security, and economic problems faced by small, isolated communities in cold climates would be greenhouse agriculture. Greenhouses would be a good solution because through technology, any kind of food could be grown at any time of year regardless of temperature and light (DutchGreenhouses). There are multiple different types of layouts or materials that can be used for greenhouse agriculture. Plastic and Glass are the most common materials that let the greenhouse use the sun for light. Plastic Greenhouses have a history of being used in large numbers in Almeria, Spain and could be a cheaper option, especially if greenhouses would be widely used (Kaushik). With the efficiency of modern greenhouses, and the small populations of Siberian villages or settlements, a reasonable amount of greenhouses would be able to provide enough for one community. One unique aspect of most of Russia is the lack of sunlight in the winter with as little as 10 minutes a day in some parts, so solar panels could be used during the summer but in the winter artificial lighting would be necessary, a feature that is within the capabilities of current greenhouse technology with the only downside being cost. This comes with the options of using mainly sunlight and growing plants in one layer, or using mainly LED and artificial lighting to grow food in multiple layers. While greenhouses may

be relatively inexpensive for a large farming establishment to own a couple, houses with all the modern technology would most likely be well outside the means of a an isolated community.

For Siberian natives, coping with the cold in agricultural practices has become a way of life. People who live there know to plant their crops neither too low in the wet taiga (which risked rot) nor too high on open lands (which risked frost), but they still face the problems of a short growing season, and the process becomes harder and harder the farther north you go(Frontiers). The usual technique for growing in colder climates is to plant crops that can handle light frosts such as carrots, beets, or cabbage, but that severely limits the array of crops that will be produced in these places (Off Grid World). Greenhouses would be a great option even for these plants because most "cold hardy vegetables can survive below freezing temperatures as long as they are not exposed to additional stresses of outdoor conditions" (Coleman) such as constant snowfall. Diversity in crops would also not be a problem with greenhouses because they can overcome the climatic circumstances in whatever region they are placed it from mild parts of Siberia to wilderness. However, technology to overcome these climate challenges can be expensive and so they come at an investment. The level of technology introduced in the greenhouse is determined by much more factors than only the climate. Along with technology comes the issue of expenses for energy, human resources and of course natural resources. Siberia just so happens to have huge deposits of natural gas. The CIA records state there are 47.8 trillion cu m of natural gas reserves in Russia as of 2018 (Central Intelligence Agency). Natural gas could be burned to heat the greenhouses, which would be an important aspect in such a cold climate, and the exhaust from burning the gases(carbon dioxide and water) could then be vented into the greenhouses to elevate carbon dioxide levels (Poudel & Dunn). This extremely effective and energy conscious method would be very successful as long as the carbon dioxide levels are monitored to make sure they could not adversely affect the people who would need to be trained to operate the greenhouses. The training of these workers would not be a debilitating expense because the greenhouses would be staying consistent with two of the major trends of the century by reducing labor through automation and investing to save on energy consumption. In the interests of the greenhouse farmers, this would help to create a competitive advantage, further capitalized on by producing crops not readily available in local markets.

Unfortunately, areas of Siberia that are going to need the most technologically advanced greenhouses that can monitor "lighting, temperature, day length, screening, relative humidity, and CO2 dosing" (Wageningen University & Research) in relation to each other are going to be the areas that can't afford it. Another challenge of Siberian winters is that plastic coverings could freeze and shatter in extremely harsh conditions. What could be an option to help with lower income settlements are "cold houses" instead of "hot houses" for winter harvests to extend growing seasons to include the whole year. Whole year growing seasons would mean the farmers could "hold [their] markets, keep crews employed, and provide a more balanced year-round income" (Coleman). "Cold" hoop houses with two layers of plastic and liner that are air-inflated would "minimize heat loss and keep relative humidity up" which would create a twice-tempered climate providing protection against freezing damage and using soil as a "heat storage medium" (Coleman). These houses are able to be used for cold hardy vegetables that are planted in succession in order to provide for a continual harvest and could be a standard size of 30x96 feet (Coleman). The day length factor can be addressed by timing, with crops being planted before winter in the hopes of getting plants to almost maturity before the day length gets too short. Depending on the latitude and economic states of cities or settlements in Siberia, the simple unheated greenhouses may or may not be an option or may be used best in conjunction with the greenhouses that use more modern technologies.

Russia has been one of the global powerhouses since the end of World War Two, and as of 2017 has a $4.016 trillion GDP purchasing power parity with 4.7% of that used for agriculture, 32.4% for industry, and 62.3% for services (Central Intelligence Agency). Despite its size, across all 11 times zones of the country only 13.1% of the land is used agriculturally and only 7.3% is arable (permanent crops: 0.1% /

permanent pasture: 5.7%) with another 49% being forest. The main agricultural products of Russia are grain, sugar beets, sunflower seeds, vegetables, fruit, beef, and milk. The labor force is 9.4% agriculture based, but more food products are imported than exported.(Central Intelligence Agency). Over the past few decades, Russia has been improving with its agriculture, especially with the assistance of its semi-presidential federation government, however there is still a disconnect between farmers and farms in education and resources, meaning that two farms of the same size growing the same crops could have noticeably different yield results (FOA). The government has the possibility of taking a major role in promoting sustainable agriculture in Siberia and the rest of its land, but this kind of progressive growth has been "stalling in recent years [as] Russia remains a predominantly static economy with a high concentration of wealth in officials' hands", partly due to the transition from "a centrally planned economy towards a more market-based system" since the collapse of the Soviet Union (Central Intelligence Agency). Though there are concerns of corruption and the voice of the people being heard by the Russian government, ordinary citizens could play a part to support sustainable agricultural practices by following sustainable methods as well as communicating them to their communities. Because of its large land mass, there is huge potential for increased agricultural production in Russia, and Siberia could be a great place to start considering the isolation that people who live there experience, and how practicing small scale agriculture in such an undeveloped space would not have large scale effects on ecosystems and the wildlife living there.

While agriculture in colder places such as Siberian Russia can prove to be more difficult than agriculture in milder climates, it is far from impossible and the challenges are always surmountable, no matter the environment, through the use of greenhouses. Growing a diverse array of crops in smaller, isolated villages would lessen the expense of having groceries transported, and many of the natural resources to operate a greenhouse can be found within Siberia itself. The prospect of growing with little environmental impact is even more exciting, and while it may be ironic that issues like global warming could actually end up helping agriculture in northern Russia and Siberia, it is still important to keep searching for possible ways to make the quality of life better for more isolated populations.

Citations :

Agostini, I. (2018, September 20). Living Conditions in the Russian Federation : Facts. Retrieved July 28, 2019, from https://borgenproject.org/living-conditions-in-the-russian-federation-facts/

Central Intelligence Agency. (2019). World Factbook Central Asia : Russia. Retrieved from https://www.cia.gov/library/publications/resources/the-world-factbook/geos/rs.html

Coleman, E. (2009). *The Winter Harvest Handbook*. Chelsea Green Publishing.

Conant, E. (n.d.). See What Life Is Like in a Hidden Siberian Village. *National Geographic*, (March 2018). Retrieved from https://www.nationalgeographic.com/magazine/2018/03/siberian-village-russia- photography/#close

Dash, M. (2013). For 40 Years, This Russian Family Was Cut Off From All Human Contact, Unaware of World War II. Retrieved from https://www.smithsonianmag.com/history/for-40-years-this-russian-family-was-cut-off-from-all-human-contact-unaware-of-world-war-ii-7354256/

DutchGreenhouses™. (n.d.). What to Grow, 19.

Ermolenko, M. (2015). Siberian Cuisine. Retrieved July 20, 2019, from https://discoversiberia.net/siberian-cuisine/

FAO Agriculture and Trade Policy Background Note Russia. (2018). FOA. Retrieved from http://www.fao.org/fileadmin/templates/est/meetings/wto_comm/Trade_Policy_Brief_Russia_final.pdf

Frontiers. (n.d.). Agriculture in Siberia | Сельское хозяйство в Сибири. Retrieved from http://frontiers.loc.gov:8081/intldl/mtfhtml/mfdev/devagrs.html

Kaushik. (n.d.). The Greenhouses of Almeria. Retrieved from https://www.amusingplanet.com/2013/08/the-greenhouses-of-almeria.html

Martins, V. J. B., & Toledo Florêncio, T. (2011). Long-Lasting Effects of Undernutrition. *US National Library of Medicine*. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3137999/

Miklós, V. (2014). Scenes From The World's Northernmost Big City—A Polluted Hell On Earth. Retrieved from https://io9.gizmodo.com/scenes-from-the-worlds-northernmost-big-city-a-polluted-1595204982

Novosibirsk mayor's office. (2019). Official website of the city of Novosibirsk : General Information. Retrieved from https://english.novo-sibirsk.ru/

Off Grid World. (2018). Subsistence Farming in Cold Climates. Retrieved from https://offgridworld.com/subsistence-farming-cold-climates/

Poudel, M., & Dunn, B. (2017, March). Greenhouse Carbon Dioxide Supplementation. Oklahoma State University.

Russian Agriculture. (n.d.). *U.S. Library of Congress*. Retrieved from http://countrystudies.us/russia/60.htm

Spector, D. (2018). Here's how many days a person can survive without water. *Business Insider*. Retrieved from https://www.businessinsider.com/how-many-days-can-you-survive-without-water-2014-5

Wageningen University & Research. (n.d.). Greenhouses. Retrieved from https://www.wur.nl/en/Research-Results/Projects-and-programmes/Unifarm-1/Facilities/Greenhouses.htm