

Mongolia: Journey From Rural to Urban Inspired by the Surrounding Bleak

John F. Kennedy once said, “Change is the law of life.” Change is exactly what tore at agricultural life in Mongolia. The 20th century proved to stabilize the agriculture centered communities of Mongolia; the Soviet Union and Mongolia had close connections and therefore created the dependent country that was ripped apart by the loss of assistance when the ties with the Soviet Union were cut (Britannica). When these ties were still present, suffering Mongolian nomads or herders would receive supplies in order to sustain at least some of their livestock during the cold and dry winters. However, now that these ties are gone, so is the once guaranteed survival of some. Mongolia not only suffered economically, but climatically and environmentally as well. Combatting cold weather is not unusual, but more often than not it is done so by watching herds of livestock freeze to death. The term, “deforestation,” is not uncommon in the modern world, but in Mongolia the term would be, “overgrazed.” It is no secret that when horses graze in a pasture, they pull up the roots of the specific crop they are grazing on; cows, on the other hand, merely eat the top of the available grass. With a combination of the Five Animals: horse, camel, cow, goat, and sheep grazing on the same pasture, the once abundant pastureland will become scarce in food source. Not only is the food scarce, but during the colder months the herd cannot access what is available if there is a coating of frost or ice on the ground. Agriculture as we know it is not present in Mongolia; most of the agriculture in Mongolia is done through the nomadic ways of life. While following their herd may yield better results in terms of food scarcity, what happens when another herd is following behind unknowingly? What happens when the weak are slaughtered to make payments on bank loans? What happens when every herder kills to save the weak from a harsh winter producing more meat causing a surplus of consumer goods which is causing the price of meat to fall (BBC News)?

Approximately 73% of Mongolian land is used for agricultural purposes and within that 73% only one percent is used for crops, leaving the majority of the land to be used for animal agriculture. If crops are grown, they tend to revolve around corn, wheat, barley and potatoes. While most of the land is used for agriculture, it is not the agriculture that incorporates typical farms, but agriculture that involves herds. Instead Mongolian farmers are known as herders or nomads. Nowadays, the nomadic tendencies that once dominated the society have dwindled down due to climatic issues. Mongolia experiences such low temperatures that there are accounts of herders watching their livestock freeze to death or wander in the snow until they eventually die because they are unable to return to the herd. Every aspect in daily life is dependent on livestock. On average Mongolians who have careers in agriculture make 760.7 thousand/month MNT, an estimated amount of 306.55 US dollars (GoGo Mongolia News). Not only does their income depend on animal agriculture, but the majority of a Mongolians diet consists of products that are provided by their livestock (Discover Mongolia and Britannica). With herds freezing to death, there is a shortage of food supplies for the families, and with a shortage of food children are less apt to do well in school. In Mongolia, primary education is required and the option for secondary education is readily available. The lack of nutrition and food affects children in their education, but health as well. According to the Central Intelligence Agency, 4.7% of Mongolia’s gross domestic product is used for health investments. The GDP of Mongolia is estimated to be 11.25 billion by the World Bank, making \$528,750,000 of their GDP benefits health care. Even with such a low percentage spent towards health care, there was a shocking decrease in infant mortality; the fertility rate for Mongolian women is approximately 2.13 children per women (CIA). Families in Mongolia have an average size of 3.6 (Arcgis) and these families are dependent on their livestock surviving and flourishing.

Overcoming obstacles is nothing new, especially in Mongolia, but so far there hasn’t been a larger obstacle than the unconquerable. In this case, the obstacle happens to be climate and you cannot change or control the weather. The only known solution used to combat weather is shelters and natural resources such as fire. Another obstacle is the lack of government support during the summer droughts and winter dzuds. The Mongolian term dzud is defined as a severe drought followed by a very severe and cold winter

that causes loss of livestock due to the lack of grazing. Animal agriculture affects Mongolia academically, economically, politically and socially. An estimated 25-40% of Mongolia's population of 2.839 million people are nomadic herders (2013 World Bank, UN Data and ATI). In Mongolia, the world hinges on the survival of animals: academically, economically and politically. Academically, whatever income comes from herding and animals is primarily put towards the children's education. Economically, animals and weather dictate the markets where the herders can make most of their income. Politically, the families will go great lengths to feed their animals even if it may be against government policy. Animals socially affects the migration of herders from the countryside to the capital causing an abundance of need for unavailable necessities.

Animals are the source of everything for the average nomadic family. When the animals are struggling, the family loses its source of income and food and without food they are at risk for losing nutrients. The herders use everything they are able to for daily life. Feces are burned for heat, meat and dairy products are used for food, and hide can be used for insulation (BBC News). Women in herding families rarely venture outside of herding; employment in agriculture is relatively equal between women and men (FAO). Mongolia requires at least primary education leading to the conclusion that Mongolian women are not deprived and can provide a source of income. Families may not purchase food if the herd is sufficient, but the herd as provides education and healthcare opportunities for the family, through income. For the past 17 years, the number of households without livestock has increased by a factor of 2.12 (FAO). Considering the drastic increases in livestock mortality over the past 50 years, the decrease in households with livestock is no surprise (IOPScience). Not only have the families suffered through the loss of livestock and a substantial rupture in their daily life, the environment has suffered as well. When ties were cut between the Soviet Union and Mongolia in 20th century, the limits placed on the heads of livestock per family were also cut. Losing the head limit meant a sudden uprise in livestock population leading to an environmental upset in terms of carrying capacity. Not only is there a possibility of going over the environment's carrying capacity, but with an increase of livestock grazing on available pasture land, there is an increased rate of overgrazing. Mortality rates are increasing yearly and there are more cases on livestock freezing to death in the past few years than before. Herders usually report a death of livestock in a Food and Agriculture Organization of the United Nations census. Through the census taken there is an alarming trend shown that there are more livestock deaths in 2010 than in the collective 32 years between 1968-2000 (IOPScience). The trends demonstrated through graphs and analysis show that the factor of animal agriculture is worsening. Due to this change, families are struggling and many are giving up their lifestyle to live on the outskirts of cities where there is a lack of running water, electricity, sewage and heat (The Guardian). Migrating towards the city costs money that the herders do not have because they depend on their livestock who have departed or the last of their income has been spent in attempts to restore their herd to a sustainable state. With a decrease in nomadic lifestyle the Mongolian herders are learning the art of consuming rather than providing.

Foraging livestock, such as those found in Mongolia, are at high risk for *Hypomagnesemic Tetany* or Grass Tetany and *Nutritional Myodegeneration* or White Muscle Disease. Each of these diseases are caused by a nutritional and thus, an elemental deficiency of Magnesium and Selenium respectively. Grass Tetany can cause muscles twitching, convulsions, staggering, and falling especially in cattle. White Muscle Disease can cause stiff walking, walking with arched backs and even severe and dire cases a calf can die within two to three days of birth. Unfortunately, these fatal diseases are hard to detect until it is too late. A common solution for small pastures is to apply the desired and need nutrient-rich fertilizer, but in Mongolia where 73% of land is used for agriculture spreading fertilizer is not optimal or feasible economically and in terms of labor. An Arduino based sensor can help detect nutrient levels in pastures; while this sensor is not available right now I have outlined a prototype design that would detect nutrient levels in soil and send alerts when levels were low. The sensor would be called the Soil Sensor Cattle

1000 or SSC1000 and would provide a source of prevention to these fatal diseases to the herd of livestock. With alerts and disease prevention Mongolian livestock mortality rates have a better opportunity of decreasing and thus, improving animal agriculture and quality of the average nomadic life.

Improving upon animal agriculture would yield an improved source of food and income. With any problem and proposed solutions, there are questions regarding feasibility. Unfortunately, by decreasing mortality rates the environmental issue of the overgrazed conditions of the pasturelands would not improve. To rehabilitate overgrazed land there would need to be additional steps taken to gain government support and time to nourish the land back to sustainable conditions. After improving these conditions there would be a new and polished agricultural system founded on the nomadic life of a Mongolian herder thereby improving daily life and a creating new balanced environment that could provide sustainability. A decrease in livestock mortality rates would cause an increase in income for the herders, reducing poverty surrounding the cities and leading to economic development in the future. One of the primary factors affecting the conditions, preventing their solutions, but there are solutions waiting to be found. Mongolia would benefit from the improved conditions leading a more balanced country. Reflecting on Mongolia's previous government and its' influence on animal agriculture showcases the importance of government policy. In order to propose a law in Mongolia, an individual, group or the President, "must provide specific information improves the existing body of laws, citing the specific impact this law would have on all interested parties." ("The Legislative Process in Mongolia") Once the law has been proposed it will be assigned to one of seven sections regarding the topic, for instance a law regarding animal agriculture would be assigned to the section of Environment and Rural Development. From there the law must go through several hearings, discussions and must be thoroughly questioned. If a law is approved in the final reading it will begin the process of publication unless vetoed by the President ("The Legislative Process in Mongolia"). While passing policies will help Mongolian agriculture there are numerous obstacles to overcome to simply propose a new law, much less pass one. There is no absolute way to overcome this legislative barrier, but the individual that goes forth to propose the law can prepare, practice and review their speech and presentation. Ordinary citizens can play a role in encouraging the government by sharing their stories and experiences of livestock mortality. Another barrier the government might face is funding in general. While it is optimal for there to be an emergency agricultural fund, it may not be feasible right away with the current budget plan. To overcome each of these obstacles it will take time, perseverance and one individual to start the process.

While facing legislative barriers, the nomads of Mongolia may face problems that involve the regulation, supply and demand of the community barns. While providing shelter for herds during severe weather conditions, how long should each herd be allowed to stay and is it fair to kick a herd out when conditions have worsened if they have exceeded their stay? Average temperatures during a Mongolian winter rarely reach above zero degrees Celsius, ("Weather and Climate:...") which means there is virtually no time for pasture to thaw thus, making the trek to the next shelter or the desired end location difficult. A proposed limitation would be two nights and three days. Two nights out of severe weather will help to lower livestock mortality, supply energy via food and might provide enough warmth for nearly frozen animals. These limitations would be in effect at every shelter in order to ensure equality. Additionally, what about supplies that will support the livestock and herder during their stay such as water, food, hay, and fuel sources? A bimonthly supply run would be made to each of the shelters in order to maintain stock, but if an emergency arose that required more than what was available at the shelter there would be an emergency supply run made as soon as the weather allowed. A geographical map of Mongolia with proposed shelters around the vast pastureland is located at the conclusion of this paper ("Mongolia Landforms"). The weather may pose a transportation problem in regards to actually delivering supplies, but tracks can be placed onto vehicles in order to ensure traction during the journey. Plows can also be accessed and used to help clear a path for the vehicles to use during deliveries. Bioenergy in itself is a

new and emerging field of research and innovation; biomass can be converted back down into Carbon-neutral fuel. While biomass may be more expensive right now, in the future, by using bioenergy Mongolia will benefit economically and environmentally. With any problem and solution combination there is always a risk factor, but one must not only consider the present but the future as well.

Controlling climate has been a continuous battle and we have slightly conquered small issues with structures and devices that promote warmth. While the herd may not travel daily due to the amount of work it takes to transport the families living quarters, they do travel in search of food. There are numerous accounts of livestock freezing to death come nightfall. Something as small as various community barns placed around the countryside could help combat the weather. By placing numerous barns around the endless Mongolian pastureland, there is space for the herd to take shelter so they are not directly left to the bare elements. The shelters would be relatively large, as the average herd contains 170 heads (FAO Resources, 1998). The architecture of the building would allow for at least 10 average size herds due to the occasional herd containing the maximum of 500 heads. In order to preserve and protect the stock the barn would be government owned and controlled. When a herder arrived, they would need to check in with the guard on shift in order to help regulate how many heads are in the barn and to be given an allotted space to place their herd in. Being in the barn alone will not prevent the temperatures from affecting the animals, but it can help prevent factors such as the wind, rain and ice. To ensure a temperature suitable for both the guard(s) on duty and the livestock there would be a furnace towards the center of building which would run on coal. Agriculture dictates the majority of the economy and environment, but Mongolia also has a large mining industry. With an abundance of mined coal there is a chance of heat during the winter dzuds. Although, the coal will negatively affect the environment, it may increase the scarce population of livestock during deadly seasons. With a possible decrease of livestock mortality rates, the herders who had moved to the surrounding areas of Ulaanbaatar, who are struggling financially and increasing the pollution rate, may consider taking up their original lifestyle of herding. The lack of heat available to the migrating herders outside of the city cause the families to burn whatever they can which heavily pollutes the surrounding area, so while the coal burning furnace would pollute the air come the winter dzuds, it seems like a safer alternative to burning anything all year round. As well as boosting the economy, the barns would show government support and with an increase in surviving livestock, the need to slaughter a multitude of a family's herd for income would decrease. If the amount of heads slaughtered decreased then the consumer's demand would be met without the usual surplus of meat. The price would be reasonable and allow for a steady income for the herders. Ultimately, the heads surviving the winter would increase exponentially and there would be a sharp decrease between the present and future. The present yields hundreds of disease ridden carcasses rotting in the sun, but hopefully in the future there would be fewer carcasses to dispose of due to the decrease of mortality rates. Reinstating the heads per herd limit would also prove to promote the environmental issues of exceeding the carrying capacity. Government issuing the policy of a herd limit and setting aside an emergency fund for devastating droughts and dzuds could also yield a positive impact to the problem. By limiting the herd to 200 heads maximum, there would be moderation in feed and mortality. This would give the environment a chance to ensure a healthy balance between ecosystems. Limiting the amount of heads, allows the grass and pasture land to grow back. In terms of supply, the limit would allow for equal opportunity between herders to make their income through the market. Having an emergency fund for agriculture set aside in the country's planned fund would increase the support given to the herders from the government, possibly decreasing livestock mortality rates. Both the funding and policy would provide for an opportunity for the herders to financially grow. Without as many heads the family has more income to spend on health care, education and is likely to save money in preparation for devastating seasons. With the help of emergency food and funding the animals are more likely to survive the seasons which in turn would decrease mortality and migration rates thus, increase the family's success and survival rate. Change is what caused Mongolia's agricultural challenges and change is going to provide the opportunity for growth and is exactly what is going to fix what's broken. The challenges that Mongolia faces daily are

those that inspire and drive research teams and scientists alike to discover and invent possible solutions to seemingly impossible problems. The solutions presented in this paper barely scratch the surface of what can be done to improve the daily challenges affecting Mongolia. Little by little, with government support and simple structures Mongolia can begin its journey to a balanced country that thrives on the sturdy foundation agriculture.

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