Exporting Semen Storage Systems to Nepal

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The agriculture sector is quite significant in Nepal, with nearly 35% of Nepal's gross domestic product (GDP) coming from the agriculture sector (World Bank, 2015). As well the dairy cattle population in Nepal is large, with 7.09 million cattle as of 2010 (United Nations, 2010) in comparison to Canada where the dairy cattle population is just under a million (Government of Canada, 2015). For this reason having equipment that will help improve breeding of cattle can be quite beneficial to the people of Nepal, in particular having a storage system for cattle semen. In order to understand why this is important for the people of Nepal, more must first be known about Nepal and the people who call it home.

Nepal is a small country, 147,141 square km, landlocked between India and China (Nepal Government, 2015), and the population is 28 million, in comparison to Canada's 34 million (Chapagain, 2015). Nepal's geography includes three major agro-ecological regions, the Mountain region, Hills region and Terai region. The Hill farming system is the main agro-ecological region focused on for this idea because of the fact that it has more land available for grazing and therefore it is more suitable for livestock, such as cattle, to be raised (Chapagain, 2015). In the Hill region the people are part of multiple ethnic communities, many of which are influenced by the Hindu culture, and they also make up the highest proportion of the Nepal population at 43% (Tiwary, 2005). The Terai region is another region that is influenced by the Hindu culture and in the Mountain farming region they are single ethnic settlements, that are influenced by the Tibetan culture (Chapagain, 2015). The people of Nepal are very culturally diverse, within their population they are influenced my multiple cultures and practices, and in Nepal there are currently around 113 official languages that are being spoken (Nepal Government 2015).

As well as having a variety of cultures, there are also a variety of agriculture practices because of the differences in geography and climate throughout Nepal. Each of the previously mentioned regions in Nepal has different agriculture practices. The Hill farming region, where most of the dairy farming takes place, is an area with sub-tropical to warm temperate climates (Chapagain, 2015). Terrace farming, which is the method of planting on steep slopes in order to avoid soil erosion (Acharya & Kafle, 2009), is the one of the most common methods of farming in the Hills region (Chapagain, 2015). Even though in the Hill region they are able to raise and produce livestock as well as grow fruits, maize, vegetables and other cash crops, there are still many difficulties plaguing this region. They are unable to transport vehicles to areas in the region, so they rely on transportation from mules and sheep, and despite being able to produce food they are still in a moderate food deficit (Chapagain, 2015). In Nepal they are in a severe food deficit and they need to be able to improve their food production in order to help feed the people of Nepal. The dairy farmers of Nepal can play a significant role in feeding the people of Nepal with improvements to cattle breeding. Providing storage systems in order to store semen will help improve breeding practices, and having semen exported into Nepal will increase the quality of cattle that are producing milk for the people of Nepal. Even though Nepal has a significantly higher number of dairy cattle at 7.09 million than Canada's population just under 1 million, the milking efficiency is significantly higher in Canada which is why Canada is able to sustain feeding a larger population of people.

Product Information

Product Description

The main product that is needed in order to improve dairy cow breeding in Nepal is a semen storage system, which is essentially a cryogenic liquid nitrogen tank with storage systems, but for the purpose of this paper they will be referred to as semen storage systems, or just storage systems, for simplification. The semen storage systems available on the market offer a long-term method for holding biological samples, and in this case semen. These storage systems are effective because they are able to hold semen in liquid nitrogen, in order to keep the sample viable, "at a temperature maintained from -184°C under the closed necktube core and to -196°C at the liquid nitrogen level" (Cole Parmer, 2015). One of the less expensive versions of this product holds 20.7 litres of liquid nitrogen, which is the cooling agent to keep the semen viable, and can hold up to 180 vials that hold 2 mL of semen (Cole-Parmer, 2015). Having this product will allow for semen samples to be held for a maximum of 245 days, which will mean only having to fill the tank with liquid nitrogen twice a year, and it keeps the semen viable for longer periods of time. The design of the product, which is 27.3 inches and height and weighs about 35lbs without any liquid nitrogen or samples in it, is pictured below in Figure 1. A general guideline of what is in the product is in Figure 2, with some differences such as the handles being in a different spot and the storage system being a slightly different shape. The purpose of this outline is to show inner and outer components of the storage system in order to get a better idea of how the product works.

The second portion of this idea is the semen to be exported in order to improve the genetics of dairy cows in Nepal, thus increasing overall milk productivity. Overall shipping the best genetics through semen can improve fertility, calving ease, health, and

productivity (Semex, 2015), all of which will help create long-term and highly productive dairy farms in Nepal.

Costs Associated with Product

There will be costs associated directly with the purchasing of semen and the purchase of the storage system, as well as accessories that go with the storage system. Semen prices in Canada from EastGen, a company that is connected with Semex for selling and distributing, for a single dose of semen it can be priced as low as $5.00 for new and lower quality to $500.00 and higher for the highest quality bulls, with the highest success rates in breeding (D. Catt personal communication, November 30, 2015). With the exchange the lowest cost semen would cost approximately 398 Nepalese Rupees (NPR), and the highest cost of semen costing nearly 40,000 NPR. To put this into perspective the more expensive semen is over half of Nepal's GDP which is currently 74,501 NPR. The other major cost associated with this export idea is the cost of the storage system. The least expensive storage system offered by Cole-Parmer Fluid Handling and Analysis, a Canadian company that sells cryogenic liquid nitrogen storage systems and accessories, is $1581.44 in Canadian dollars, and is 126012.92 NPR. This is nearly 1 and ¾ times Nepal's current GDP. Accessories that include vessel measuring rods, a roller base for the tank, and gloves and aprons for handling the storage system are picture below in Figures 3-6. The costs for the accessories are as follows, vessel measuring rods: $16.57 CDN or 1319.86 NPR, roller base: $353.94 CDN or 28190.18 NPR, gloves: $197.30 CDN or 15713.26 NPR, and aprons: $296.71 CDN or 23630.12 NPR. When the cost of the unit is added to the costs of the accessories to the unit the total cost is $2445.96 CDN or 194819.80 NPR (Cole-Parmer, 2015). This cost is too high for

the people of Nepal to purchase, to limit costs looking at not purchasing the accessories or buying lower cost options of the accessories could help minimize this cost. As well splitting the cost between the farmers of Nepal could help minimize costs.

Labour Required

In order for this project to be successful farmers will either have to bring their cattle to a location where the storage system is located in order to breed her, or they must bring the semen to the cattle. This may be time intensive because of the lack of quick and easy transportation to the hill region (Chapagain, 2015) where dairy farms are most prevalent, depending on the distance between where the semen is stored and where the farms are located. Part of the purpose behind this idea is to make breeding simpler and less labour intensive for farmers. If farmers are still using traditional methods of breeding that include working hands on with a bull, using artificial insemination can help make the breeding process much less labour intensive.

Inputs Required

Liquid nitrogen is a required input in order to keep the semen viable for use. Liquid nitrogen is used in order to cool the tank and keep the semen at a temperature so that it can be used after a long period of time. Costs of liquid nitrogen can vary based on the amount that is being purchased and from where you are purchasing it. The price of liquid nitrogen was approximately 6 cents per litre as of 1994 (Sheahan, 1994), but has most likely increased a little bit in the last 20 years. At a price of 6 cents per litre it is a very affordable input for the storage system.

Potential Issues

One of the largest potential issues with this export idea is acceptance from farmers in Nepal, as well as potentially having to teach farmers how to handle the equipment, and furthermore potentially have to teach them to use more modern breeding practices if they are used to using traditional. Since the people of Nepal speak an abundant number of languages it is difficult to come up with one language guide that could help guide Nepali farmers through the process. Even though the literacy rate has improved to 89.2% for males in Nepal and 77.5% for females in Nepal (Unicef, 2013), there is still the potential that if there is a written manual explaining the products that some farmers will not be able to use it and therefore will not be able to fully learn how to use the product. This can be improved by having designated members of each community test the product first, learn how to use the storage system and how to artificially inseminate their cows if they do not already know how to do so. As more people learn how to use the product they will be able to teach other members of their farming community as well. The other potential issue is the cost not only of the storage system, but the additional cost such as importing semen from Canada. It is difficult to quantify the long-term benefits of improving cattle breeding in comparison to what the initial cost of the product is. Even if the idea is widely accepted by Nepali farmers the cost will most likely be too expensive for them to afford on their own. If Nepali farmers combined their money they can potentially afford the product but this depends on the wealth of the farmers, the location of the farmers in proximity to each other to share the product, and the farmer's willingness to invest in an expensive product.

Market Opportunity

The Food and Agriculture Organization of the United Nations did a study looking at the dairy sector in Nepal and found Nepal has the opportunities to greatly improve their dairy livestock production. According to the study there is an increase in opportunities to sell milk and byproducts of milk because of the fact that Nepal has developed more densely populated urban areas (United Nations, 2010). As well the study found with an increase in the private sector of the dairy industry in Nepal there is new establishments that can support a higher level of dairy production. The part of this study that pertains most to the idea of semen storage is that there is inadequate breeding support due to a shortage of bulls that improve breeding as well as proper artificial insemination services. By bringing new breeding tools and equipment to the farmer's of Nepal it will open up new market opportunities for them as well as for the generation that follows because with more genetically strong bulls being bred to cows throughout generations it will create stronger offspring in the long-term, which the next generation of Nepali farmers will be raising.

Export Potential to Nepal

Transporting the Product

Shipping the semen to Nepal would depend on whether the semen was shipped directly from Canada or from a distributor closer to Nepal. The ideal situation for this export is to have the distributors of Semex in India ship to Nepal. This reduces the overall cost of shipping to Nepal, but the profit from the sale is being calculated into Canada's Gross National Product (GDP). For the storage system the shipping calculated through UPS and the shipping through the company that produces the product to ship Toronto is approximately $800 CDN or 63706.55 NPR for the UPS shipping (UPS, 2015) plus

approximately $61.00 CDN or 4857.39 NPR for the shipping from Cole-Parmer (Cole-Parmer, 2015).

Benefits to Canada

The benefits that Canada will have if they export semen and storage systems to Nepal is small economic. Agriculture plays a smaller role in Canada's overall GDP but this idea not only includes agriculture through exporting semen it also includes manufacturing. The initial purchase of the product helps a Canadian company continue to be profitable, and with continuing to buy accessories from Cole-Parmer it continues to feed into the Canadian economy. With the agriculture sector in order to have long-term breeding improvement, new semen doses are going to be purchases and that goes into Canada's GNP. Both of these are smaller economic gains in the spectrum of all the exporting Canada does around the world, but in this scenario the benefits outweigh the costs. If products are being purchased at market value from Canada than the Canadian economy is gaining money, and there is no extra input going into the product versus when it is sold in Canada. In comparison between Nepal and Canada, the benefits for Nepal are much larger than those in Canada.

Benefits to Nepal

Livestock accounts for about 12% of the 34.3% of the agricultural percentage of Nepal's GDP (Bikash & Kamal, 1997). For this reason improvement to this sector in Nepal is important and can benefit Nepalese farmers for a variety of reason. At the time of the 1997 study 90% of dairy farms were producing only for their own household, and because of the average size of a herd in Nepal (see Figure 7) it is most likely because the families are only producing enough to feed their families, with some having the potential

to sell for money. In Figure 7 posted below there are significant differences between dairy farms in Canada and those in Nepal. Nepal has approximately 7 times the dairy cows that Canada has, and Canada has an average herd size 17 times larger than Nepal, and each dairy cow in Canada produces on average 3 times more milk in a day in comparison to Nepal. These numbers are important to note because it is clear that Nepal has the potential with the number of dairy cows to produce larger quantities of milk. Semex produces the best cattle genetics in Canada and exporting this to Nepal gives them access to the benefits that come from good breeding. The potential benefits for improved health, fertility, easy calving (Semex, 2015), are important but most important the potential for an increase in milk productivity. In order to have a high productivity there has to be improved conditions for the animal to thrive. A study done in Nepal found that milk production was quite low and contributed it to a few factors, genetics was one of the factors, but as well disease was a factor and most prominent low nutrition was cited as a reason for low milk productivity (Redding et al., 2012). In order for improved genetics for selective breeding to be most successful both of those issues will have to be targeted in the long-run as well. Another study found that genetic selection does increase productivity but as well found that animal welfare needs to be an important factor in raising the animal in order for it to be productive and to limit negative consequences such as behavioural problems or immunological disorders (Oltenacu & Broom, 2010). With the increase in milk productivity it opens up new markets for Nepali farmers and for all the people that work in jobs where milk is used as a product or is sold, an example is shown below in Figure 8. Nepal has the potential to greatly benefit from an increase in milk productivity.

Companies to get Involved

The two key companies to be involved with the product are Cole-Parmer Fluid Handling and Analysis and Semex. Cole-Parmer is the company that sells the storage system as long as any accessories and equipment to go with it. Semex will be the company that supplies and exports the semen to Nepal. Since Semex has a distributor in India there is the potential for the product to be shipped directly from India to Nepal.

Documentation Required

Canada and Nepal will need the proper documentation from the Canadian and Nepalese government to export semen. According to the Canadian Food Inspection Agency there are export documents in place in order to export bull semen to Nepal (Canadian Food Inspection Agency, 2015). If the storage system is transported directly from Canada to Nepal it should only have to go through general airport screenings.

Regional Competition

There is currently a project in Pokhara, Nepal that will create regional competition is a storage system is exported to Nepal. This project is currently working on collecting semen from cattle, buffalo and bucks in Nepal for artificial insemination (NLBC Administration, personal communication, November 26, 2015). They do not export or import semen but they currently have a large operation that includes 500 liquid nitrogen tanks that each hold 50 litres of storage and they have 1102 inseminators working on this project (NLBC Administration, personal communication, November 26, 2015). This company is not a competitor for exporting semen because the semen is all from Nepal and they are not importing semen from any other countries. They are

however a competitor for exporting a liquid nitrogen storage system from Canada since they have 500 liquid nitrogen tanks.

International Competition

If Canada is to attempt to export a storage system to Nepal there will be competition coming from large countries that are closer to Nepal. A large company that is sourced out of China called Alibaba would be in direct competition with products being shipped from Canada (Alibaba, 2015). This company offers the same type of storage system that would be exported out of Canada to Nepal. Due to the fact that China is considerably closer to Nepal than Canada is, exporting the product from China will cost considerably less from a shipping standpoint, and the product can cost less depending on exchange rates and competitive pricing. From the standpoint of exporting semen to Nepal there is considerably less competition because of the fact that Semex is an internationally renowned company. Due to the fact that there are distributors located close to Nepal, for instance there is a supplier of Semex products located in India (Semex, 2015), there will be less potential for competition from other neighboring countries unless those countries can offer competitive pricing for the same quality of product.

Conclusion

Exporting semen and semen storage systems is not currently a viable option for Nepal, at least not from Canada, currently because of the costs associated with startup, equipment, and the inputs that will be needed in order for it to benefit in the long term. If the cost of the storage system can be subsidized by a government grant then it will become a more viable option because it is the biggest cost associated with the export

idea. If Canada moved forward with this export idea it would damage the work that NLBC Pokhara has been working on in Nepal. This could potentially affect the jobs of 1102 inseminators working on this project. The best idea moving forward would be to work with this team in Pokhara, with their permission, who currently has access to semen storage tanks and discussing the possibility of shipping in semen to store, opposed to just storing semen that is produced in Nepal. In this scenario it keeps that team employed in Nepal but Canada's input of semen with strong genetic traits could help improve the project and the breeding selection in Nepal. By only using semen that is sourced from Nepal there will not be the same genetic guarantee as the semen that is sourced and provided by Semex in Canada. If Canada were to work with the team in Pokhara by exporting semen for their project it would limit the cost to the farmer's in Nepal. The combination with the team in Pokhara would combine Canadian semen genetics, and the proper breeding equipment in order to best improve breeding in Nepal. More research into dairy cattle in Nepal will be beneficial moving forward since many of the sources are from ten to thirty years ago and therefore might not be as accurate. Nepal can also benefit from exploring the idea of other countries that are closer to export cattle semen to them as this can potentially lower the cost of the specimen, as well as lowering the cost of the transportation. Nepal has the numbers to produce a high quantity of milk but needs higher quality cattle in order to improve milking efficiency; research into genetics can help improve milk efficiency. If researchers in Nepal are able to selectively breed the best traits from the dairy cows that are already in Nepal this can improve the genetics and the health of the herd and can also improve the milk efficiency. Nepal can also benefit by researching what other factors can help improve their cow's health and milking

efficiency, such as quality of the feed, and prevention of disease. In order for the proposed idea to work, or any other idea involving improving milking yield for dairy cattle, there has to be a large financial input in order to see long-term success. If the government and the people of Nepal can come up with a way financially to fund this idea they will see great benefits in the long run. Having the best genetics in breeding cattle can help prevent diseases, and increase the quantity of milk, and having an improved method of breeding where the process is streamlined so that farmers do not have to work hands on with the bull, it can greatly improve the safety of farmers in Nepal. The recommendation is to combine the work of Canadian's in agriculture in semen production, and with the people of Nepal and their work with artificial insemination and semen storage. This will limit the costs in the short-term and in the long-term, as well it will provide Nepal with all the benefits that come with selective breeding, and artificial insemination.

Word Count:

Tables and Figures

Figure 1 (Cole-Parmer, 2015)

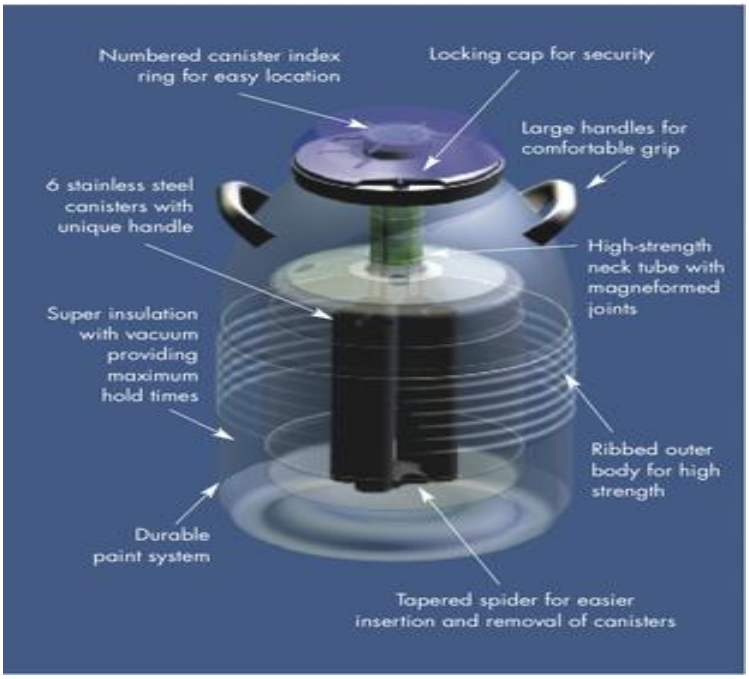

Figure 2 (L&G Cryogenics, 2015)

Figure 3 (CT Cryogenic Incorporated, 2015)

Figure 4 (Cole-Parmer, 2015)

Figure 5 (Cole-Parmer, 2015)

Figure 6 (Cole-Parmer, 2015)

	Canada	**Nepal**
Number of Dairy Cows	Nearly 1 million (Farm and Food Care Canada, 2012), as of 2014 approximately 959,300 dairy cows (Holstein Canada, 2014).	7.09 million dairy cows (United Nations, 2010)
Average Milk Yield	30 litres of milk per day (Farm and Food Care Canada, 2012).	8.37 litres of milk per day (Bikash & Kamal, 1997)
Average Number of Lactations	4-5 lactations, but can be up to 10 (Farm and Food Care Canada, 2012).	**N/A- Unable to find current and accurate information.**
Average Herd Size	70 cows per farm (Farm and Food Care Canada, 2012)	Approximately 4 cows per farm (Bikash & Kamal, 1997)

Figure 7

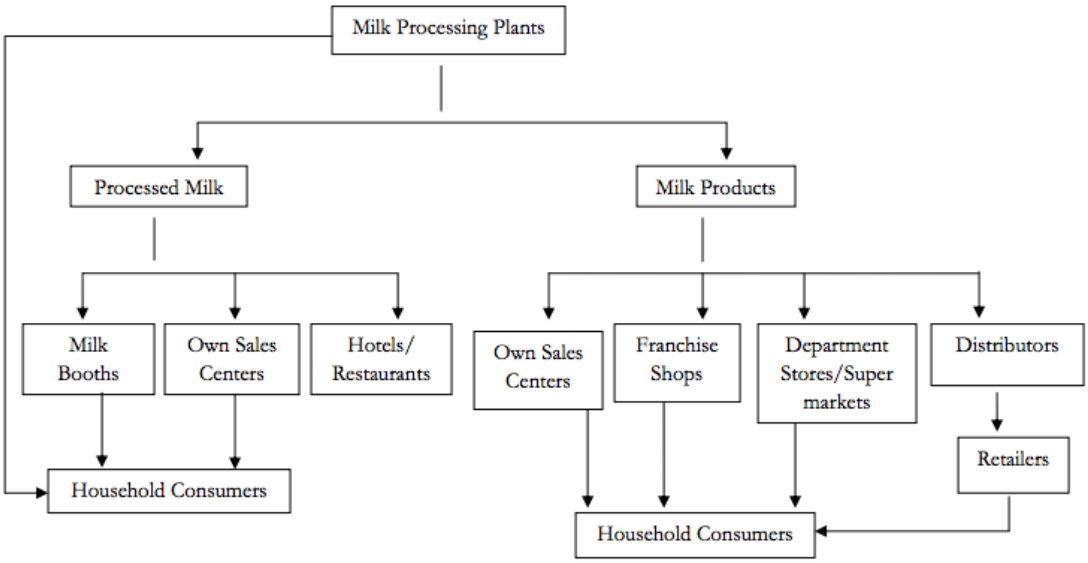

Figure 8 (United Nations, 2010)

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